Australian Government

Department of Transport and Regional Services

Bureau of Transport and Regional Economics

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Optimising harmonisation in the Australian railway industry

report 114

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ISSN 1440-9569

ISBN 1 921260 00 9

This publication is available in hard copy or PDF format from the Bureau of Transport and Regional Economics website at www.btre.gov.au—if you require part or all of this publication in a different format, please contact BTRE.

Published by
Bureau of Transport and Regional Economics,
GPO Box 501, Canberra ACT 2601, Australia.
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E-mail: btre@dotars.gov.au, internet: http://www.btre.gov.au

An appropriate citation for this report is:
Bureau of Transport and Regional Economics [BTRE] 2006, *Optimising harmonisation in the Australian railway industry*. Report 114, BTRE, Canberra, Australia.

Desktop publishing by Thomas Smith.

Cover photo courtesy of Mr Brad Hinton.
Figures 3.2, 3.4, 3.12 & 3.13 photographs courtesy of Mr Mark Carter GRMS*MEDIA*.

Printed in Canberra by CPP.

Foreword

In the last decade, Australia's railways have undergone an ownership, operational and technological revolution. The establishment of national public and private train operators has finally brought seamless rail freight services across the country. There has been a complementary development in track management, with one manager (Australian Rail Track Corporation) rather than five, now controlling most of the interstate track. The standardisation of the Melbourne–Adelaide railway in 1995 removed the break-of-gauge on the East–West Corridor. This has facilitated the subsequent more than doubling of rail freight task between those cities. Infrastructure investments and complementary funding of new generation locomotives have enabled train operators to harness train economics of heavier, longer trains, for instance, with Melbourne–Adelaide trains now 50 per cent longer than a decade ago.

These changes are transforming the industry. However, the perception is that the legacy of the separate State-based networks may still draw a long shadow over the performance of the network. This report investigates the extent to which physical, operational and regulatory breaks-of-gauge impede the industry. The report provides guidance to policy makers and industry on those issues.

The authors are grateful to those who assisted in the development of the report. In particular, David Bray provided constructive comments, in his role as an independent reviewer of the draft report. Louise Oliver provided invaluable editorial guidance. We acknowledge the indispensable comments and insights provided by various railway industry firms. The authors also recognise the contribution of their colleagues, particularly Lyn Martin and David Mitchell.

This study was undertaken by Peter Kain, under the guidance of Phil Potterton. Assistance was provided by David Holford, Damon Barrett and Ben James.

Phil Potterton
Executive Director
Bureau of Transport and Regional Economics
September 2006

At a glance

- Governments have long appreciated the adverse effects of inconsistencies between different State-based railways. Such inconsistencies are entrenched by devolved and jurisdictionally-based decision-making, muted commercial pressures and historically-small interstate traffic flows. However, strongly growing interstate and regional commerce increases the urgency for harmonisation due to the number of interfaces involved.
- Multiple standards may be desirable where customised specifications can co-exist with little efficiency loss, or are more efficient than a single standard or there are low financial returns on standardisation.
- Customised technical specifications can co-exist efficiently where there is low-cost bridging technology. But it is not always possible to devise such low-cost technology, such as where different railway gauges converge.
- 'Optimal' physical and regulatory harmonisation does not require the complete standardisation of systems—there can be benefits in customised specifications. Physical standards and regulatory oversight should be tailored to reflect the variable physical conditions such as geography and operational safety risks and commercial conditions such as cost recovery, industry structure and ownership. But, to the extent that these physical, commercial and operational boundaries are then overlayed with jurisdictional boundaries, the number of interfaces between different systems is multiplied.
- Physical standardisation can be operationally desirable but there may be low returns on such investment—there is often no business or economic case for pursuing greater standardisation until equipment needs renewal. However, there are lesser costs in regulatory harmonisation.

- In the last decade, mandatory access regulations have been introduced, with complementary safety and pricing regulations. However, while jurisdictions introduced these regulations with the ideal of consistency, the reality has been diverging regulation. Ongoing initiatives have pursued convergence but, nonetheless the result is regulatory breaks-of-gauge.
- The primary cost to the industry of this is the time lost by railway operators. This cost is especially relevant for industry safety management, where inconsistent regulations inevitably lead managers to be reactive to safety rather than proactive.
- Australian and overseas experiences illustrate that multiple regulatory systems are inherently unstable—ongoing resources are required to maintain that consistency.
- Overseas models involve regulatory structures with clearer regulatory boundaries and fewer regulatory overlaps. Such structures then require less effort in achieving and maintaining regulatory harmonisation.

Contents

Figures

Tables

Executive summary

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The Australian railway system is famous for its construction with three different rail gauges. The multiple gauges became a major impediment to the flow of freight between States. It took 140 years for Australia to overcome its gauge problem on its interstate links.

There has been considerable progress in the last decade in transforming the State-based railway systems into a network that more closely echoes growing national freight transport needs. In this context, notable events have included the commencement of national rail freight operations (as National Rail) in 1993, the completion of the interstate standard gauge network in 1995 (with the conversion of the Melbourne–Adelaide broad gauge line) and the development of the Australian Rail Track Corporation's business since its establishment in 1998.

The railway gauge is one of a range of areas in which the railway system is perceived to be fragmented—where there may be a case for greater harmonisation. Other technical, operational, regulatory and administrative inconsistencies have also impeded the flow of traffic across the system.

The impact of physical and regulatory diversity depends on the extent to which there are flows across the relevant physical and regulatory 'break-of-gauge' interfaces. For the railway industry, the number of interfaces has increased as traffic levels rose across those interfaces. Non-optimal diversity in physical and regulatory systems has similar adverse impacts on the industry.

This report therefore assesses the case for greater harmonisation.

Achieving optimal harmonisation

Harmonisation may deliver benefits such as lower input costs, improvements in operational efficiency, higher inherent safety and lower training costs. It can also widen rail's freight market. However, optimal harmonisation involves balancing the benefits of standardisation with those of customisation. A degree of customisation can be more efficient than fully standardised systems. This study points out that this trade-off is particularly important where there are varying market or geographical operating environments or varying financial and safety risks.

The merits of customisation relative to harmonisation depends on the benefits arising from having that diversity and the bridging costs that arise in linking diverse systems.

Optimal harmonisation necessarily reflects the inherited standards—that is, the strategy is 'path dependent' on the historical decisions. This is important for Australia's railways, with a history of local, independent, decisions on standards, long-lived infrastructure and low returns on investment. This means that optimal harmonisation in the industry is highly unlikely to lead to early asset replacement in order to achieve a standard specification.

However, even where greater harmonisation may be warranted, commercial pressures will not necessarily bring it about. Sub-optimal standard-setting and standard-adoption can arise due to market failure and market imperfections. However, this is less likely to arise in network industries because of the strong financial inter-dependence between industry players.

Sub-optimality can arise where the benefits and costs of harmonisation fall unevenly across industry players. If in aggregate there are significant gains from greater harmonisation, we might expect that major beneficiaries will have the incentives to share their disproportionate benefits with those parties that bear a disproportionate share of the costs. This negotiating task is relatively easier to achieve when there are relatively few industry players, as in Australia's rail industry.

Government can intervene to set and enforce physical standards. However, while government has that fiat, it does not necessarily have the superior knowledge to identify appropriate standards. Such an intervention can worsen rather than enhance welfare. This outcome is less likely where the government role is less intrusive, such as where it co-ordinates or facilitates between industry players.

Most Australian railways were government-owned and operated until recent years; they were also based around separate federal and State jurisdictions. Thus, commercial pressures were muted (and political influences stronger), with decisions being made by sovereign governments. Further, in the past the national economy had reflected aggregation of intra-State activities rather than a cohesive interaction between the States and interstate flows were relatively unimportant.

Thus, the federal structure of decision-making, the muted commercial pressures and the relatively small interstate traffic flows acted against the industry developing a greater degree of harmonisation-the legacy of which remains today. Commercialisation and privatisation and growing interstate traffic provide greater pressure for, and benefits from, increased harmonisation. However, despite privatisation of much of the industry, regulations are still developed and applied by each jurisdiction. Consistency across jurisdictions is not guaranteed.

Technical harmonisation

The impact of an inconsistency is greatest where there are high traffic flows and where the costs of bridging that inconsistency are large. This is particularly the case with breaks-of-railway gauge, with high trans-shipment costs, unnecessary duplication of rolling stock and time delays. However, the levels of freight flowing across the remaining breaks in Australia are very modest. Consequently, the direct transport costs of those inconsistencies are low and the financial case for standardisation is likely to be weak.

There are other areas of infrastructure diversity. Train capacity standards (loading outline, axle loads and trailing load) vary considerably across the network. These differences reflect, in part, practical solutions arising from the varying terrain and from the standards needed to meet the traffic flows. The differences also reflect the legacy of independent State-based management. There is a case for some diversity in track, train and terminal capacities. This reflects varying demand for capacity over different parts of the network and differing costs of provision. However, the case for investing in greater standardisation depends on individual cost-benefit assessments.

The case for diversity in safeworking and communications is less clear-cut. There are different forms of communicating instructions to drivers, different authorities to proceed and different ways for signallers to establish train location. Similarly, communications systems are inconsistent *and* lack interoperability. This leads to high bridging costs: there is a need for additional training and equipment and it is harder to achieve given safety standards. Common management of most of the interstate network should ensure that, as the business case for replacement of the systems comes about, the new systems should be to a common standard or compatible (through protocol standards). However, because the assets are long-lived, this process will be protracted.

Regulatory harmonisation

Railway-specific safety, pricing and access regulation has been introduced in the last decade. The regulations have their roots in mandated track access. Each jurisdiction has established safety regulators (replacing industry self-regulation) and access regulators. At present there are about 200 safety-accredited (licensed) rail organisations. The safety regulations are based on 'co-regulation', which is neither entirely 'self-regulated' nor 'prescribed regulation'.

Optimal regulatory harmonisation nonetheless requires diverse access and safety regulations. This is because diversity in ownership, industry structure and operational environment means that regulatory decisions must be tailored—it is sub-optimal to prescribe a single form of regulation. Nonetheless, optimality could still be achieved within the structure of national-based regulators. Diverse solutions do not necessarily require a multitude of regulators for each situation.

What is the impact for industry players facing multiple access and safety regulators? When a player moves across regulatory interfaces, the bridging (transaction) costs can include significant management resources. Specifically, those management resources can represent considerable opportunity costs, notably where the attention and pro-activity of key safety managers is diverted to managing the multiple regulatory systems. Further, additional resources are also required for tailoring the training and auditing for each system. Managers also need to devote time to seek and *maintain* consistency, especially when facing unilateral regulatory decisions. Such unilateralism implies an inherently unstable regulatory system.

Insights can be gained by assessing experiences in other federal systems. To the extent that railway regulations in Canada occur at federal and provincial levels, that country has also experienced regulatory instability. Efforts have been made to seek and maintain harmonised safety regulation but in the absence of automatic tranposing of federal revisions into provincial regulations, consistency is lost. The federal regulatory revision process that comes with performance-based regulations almost inevitably leads to disharmony unless a province automatically transposes the federal regulations.

The regulatory track record in Australia in the last decade is one of regulatory instability. Since the establishment of State regulatory bodies in the 1990s, the regulators have sought to maintain consistency. Despite the signing of intergovernmental agreements on "rail safety" and on "rail operational uniformity" (in 1996, and 1999, respectively), jurisdictional safety regulators continued to develop safety regulations on an individual basis. Regulatory systems diverged from the outset.

Efforts have been made to harmonise and simplify rail regulation and operation, with the establishment of 'one-stop-shops' (for track access) and mutual recognition (for accreditation). In June 2006, the Australian Transport Council endorsed a national model Rail Safety legislative package, to facilitate consistency in national rail safety regulations. The challenge will be to ensure that this initiative to achieve and maintain regulatory consistency will deliver the necessary harmonisation remedy for the risk/risk management/jurisdiction matrix.

In embarking on this safety initiative, the governments have recognised that concerted efforts are required to achieve consistency and to prevent divergence. Overseas regulatory systems offer alternative approaches to achieving and maintaining consistency. Overseas models include adopting a single multi-function regulator (as with safety, access and pricing regulation in Great Britain) or a strong federal railway regulator (such as in the United States), with clear delineation between federal and state responsibilities, that is, that the federal regulations on federal railways prevail up to and including the interface with state-regulated systems. At the same time, it should be noted that the constitutional backgrounds in overseas federations (the EU, the USA and Canada) may be more conducive to centrally-based approaches than in Australia.

Introduction

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The Australian railway system is famous for its construction with three different rail gauges. The multiple gauges became a major impediment to the flow of freight between States. Less well known is that this problem was common in other countries. For instance, in the United States, railways were built to over 20 different gauges. However, the private companies that built those railways had converted them to a common gauge by the mid-1880s. It took 140 years for Australia to overcome its gauge problem on its interstate links.

But railway gauge is not the only area in which the railway system is perceived to be fragmented. Other technical, operational, regulatory and administrative inconsistencies have also impeded the flow of traffic across the system.

There has been considerable progress in the last decade in transforming the State-based railway systems into a network that more closely echoes growing national freight transport needs. In this context, notable events have included the commencement of national rail freight operations (as National Rail) in 1993, the completion of the interstate standard gauge network in 1995 (with the conversion of the Melbourne–Adelaide broad gauge line) and the development of the Australian Rail Track Corporation's business since its establishment in 1998.

The development of a more unified system enables the network to operate as a national system. However, this transformation in network provision and usage exposes two areas where there are harmonisation issues:

- railways' own internal technical environment—with consistency in their equipment;
- consistency in the external environment—specifically in regulatory oversight of the railway industry.

These are relevant issues for Australia's railway industry. In technical issues, for example, there are lingering physical and operational inconsistencies, such as diverse signalling and communications systems.

The external environment also raises harmonisation issues—in the context of Australia's federal system and the recent expansion in structural, access, economic and safety regulation. Is there consistency in the regulations? The Productivity Commission has noted:

> ...though there has been considerable reform over the last decade it has occurred jurisdiction by jurisdiction, resulting in the development of a multiplicity of access regimes and overlapping regulatory bodies. This regulatory fragmentation has been likened to the break in the rail gauge at State borders in inhibiting the efficient operation of trains across Australia. (Productivity Commission 2004a, p. 185)

Previous reviews

This is not the first study to consider rail harmonisation and standardisation issues. Other recent reports that have considered various aspects of harmonisation include:

- Maunsell 1998, *Study of rail standards and operational requirements*;
- Booz Allen & Hamilton 1999, *Independent review of rail safety arrangements in Australia*;
- The Productivity Commission 2000, *Progress in Rail Reform*—Chapter 9 (Safety regulation and operating procedures and standards);
- Booz Allen & Hamilton 2001, *Interstate rail network audit*, Report prepared for Australian Rail Track Corporation;
- ACIL Consulting 2001, *Status report of the progress of rail reform in Australia*;
- Department of Transport and Regional Services 2000, *Regulation impact statement. Draft code of practice for the defined interstate rail network*. Volumes 1, 2 and 3;
- Allen Consulting 2001, *Regulation impact statement. Draft code of practice for the defined interstate rail network*. Volume 4: Track, civil and electrical infrastructure;
- Allen Consulting 2002, *Draft regulation impact statement. Freight loading manual for the defined interstate rail network*;
- Affleck 2003, *The Australian rail industry: overview and issues*;
- Booz Allen Hamilton 2003, *Railway communications strategic directions project*; and
- Maunsell 2003, *Double stack access in south eastern Australia*.

Only the Maunsell (1998) report considers the breadth of harmonisation issues in detail.[1] Nonetheless, a general theme of harmonisation issues runs through each of the reports and these issues are significant. For example, in its submission to the Productivity Commission's study, National Rail noted that a major external issue adversely affecting the rail operator's progress is 'costs caused by lack of harmonisation of operational rules, operating practices and related infrastructure (e.g., signalling and communications)' (National Rail 1998a, p. 12).

The Australian Rail Track Corporation Audit is notable because it covers physical harmonisation issues on the national network, though it focuses more on investment than harmonisation *per se*. Nonetheless, the thrust of the audit's identified infrastructure works involves the harmonisation of physical outputs. This would enable trains to operate across the intercity network to enhance train economics and, hence, improve the viability of the infrastructure manager.

This study

This study is intended to add to the debate in two principal areas. Firstly, it provides a stock-take of outstanding harmonisation issues—both technical and regulatory—and considers where harmonisation, or other strategies, may be merited. Secondly, the authors identify where inconsistent technical standards and regulatory arrangements across the network may impede railway efficiency. They then outline the principles that should guide the development of more efficient arrangements.

1 The other studies highlighted harmonisation issues, some of which were identified as meriting further consideration. In Appendix IV, we present a list of the principal harmonisation issues that were raised in those reports.

Chapter 1

Overview of standardisation and harmonisation

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Background

In this chapter we present an overview of standardisation and harmonisation issues in the Australian railway industry. We commence with an overview of the industry and review the very substantial changes to the industry since the early 1990s. This overview considers:

- current traffic patterns—the continuing importance of urban passenger operations, the bulk goods movements and the resurgent intermodal traffic
- changes in traffic—growing mine-to-port and intermodal freight
- changes in business operation—more commercially-focused
- changes in ownership—privatisation
- changes in policy and regulation—especially mandating access and industry-based safety regulation
- changes in structure—notably vertical separation and horizontal integration.

We then review what is meant by optimal harmonisation and consider it in the context of the railway industry. Finally, we consider recent developments and issues in harmonisation.

Australian railway industry

The opening of the Darwin railway in 2004 completed the railway industry's links between mainland capital cities. The industry provides a service in several important passenger and freight markets. These services, and the task that has been performed in the recent past, are shown in Table 1.1.

In this table we have characterised the industry in two main types of passenger operation—urban passenger and non-urban passenger—and three primary freight types—ores & minerals, 'seasonal' (grain) and non-bulk. The passenger task (defined either as journeys or passenger-kilometres) is dominated by urban passenger movements. Urban passenger movements comprise approximately 71 per cent of all passenger kilometres and virtually all passenger journeys. The

1.1 Australian railways' task performance [c]

Task			Output	Total output
Urban passenger	(passenger kilometres) 2002–03 [b]			8.26 billion
	(journeys) 2002–03 [b]			466.00 million
Non-urban passenger	(passenger kilometres) 2002–03 [b]			2.36 billion
	(journeys) 2000–01 [a]			9.755 million
		Countrylink	*1.554 million*	
		V/Line Passenger	*7.097 million*	
		Traveltrain (QR)	*0.607 million*	
		Great Southern Railway	*0.240 million*	
		Transwa	*0.258 million*	
Ores, coal & minerals	(net tonne-kilometres) 2002–03 [b]			131.09 billion
		Ore	*66.84 billion*	
		Coal	*44.37 billion*	
		Steel	*4.83 billion*	
		Nickel	*0.84 billion*	
		Other	*14.20 billion*	
Seasonal—grain (net tonne-kilometres) 2002–03				5.06 billion
Non-bulk—including intermodal (net tonne-kilometres) 2002–03				21.92 billion

Source [a] BTRE 2002.

Source [b] Australasian Railway Association 2004.

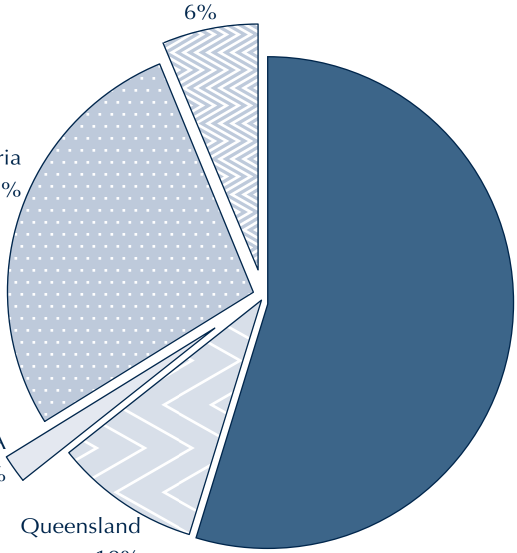
Source [c] Data are for public and private common-carrier railways and private mineral lines but excluding sugar tramways.

primary freight task is dominated by ores, coal & minerals and non-bulk (including container traffic).

Thus, we can characterise the national rail passenger task as being concentrated in urban 'islands'—essentially, the State capitals. The main freight tasks are between, but also pass through, those urban passenger islands. The physical size and task of each of those islands varies. New South Wales (primarily Sydney) and Melbourne dominate. Figure 1.1 illustrates each State's percentage of passenger journeys by task.

The three primary freight markets have very different operating characteristics. The seasonal grain and the ores (etc) are both bulk movements and often move from hinterland to port. While grain is received from a wide catchment, the ores (etc) are often movements from a single mine to a single port. For the non-bulk freight there is one feature that is highly relevant for this study. Cross-border—that

1.1 Passenger journeys task, by State, 2003 (percentage of total)



Source: Data from Australian Transport Safety Bureau web site.

is, interstate or cross—jurisdictional—non-bulk freight was over 90 per cent of the total non-bulk tonne-kilometre rail task in 2002–03.[2]

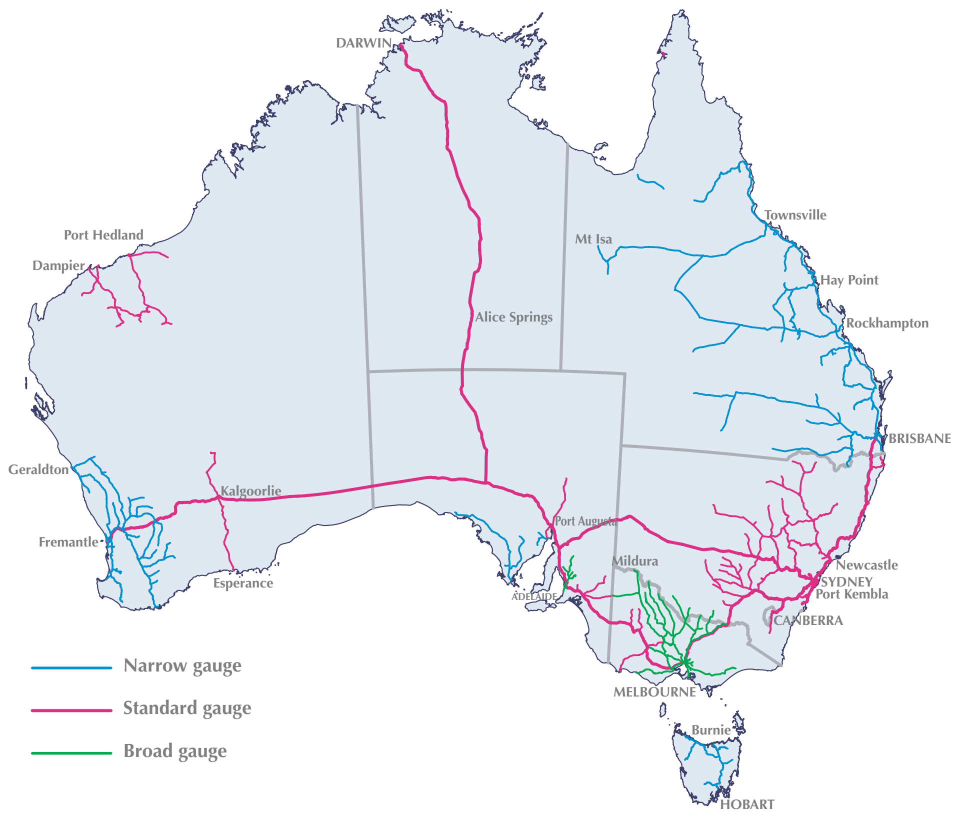
Trends in these freight markets have also varied. Traffic in ores, coal & minerals has grown very strongly in recent years. The tonnage rose from 166 million tonnes in 1975–76 to 516 million tonnes in 2002–03. By contrast, traffic in grains has been largely static at around 13 million tonnes in 1975–76 and 2002–03. Traffic in non-bulk freight rose in the same period from approximately 15 million tonnes to around 16 million tonnes (Bureau of Transport Economics 1979a, p. 12; Australasian Railway Association 2004, p. 9). However, this tonnage figure masks strong growth in longer corridors (Brisbane–Melbourne and Eastern States–Perth), static traffic levels on shorter corridors (such as Melbourne–Adelaide and Sydney–Melbourne) and declines on the shortest corridors (such as Sydney–Canberra) (Bureau of Transport and Regional Economics 2003).

2 This figure was derived from ARA 2004, Table 3, p. 9.

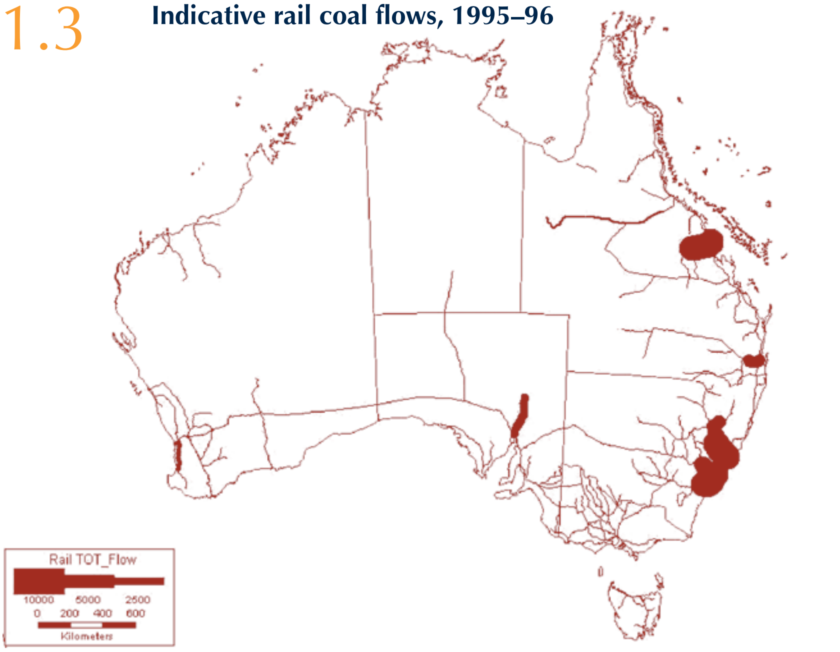
Thus, most of the rail freight task is bulk haulage of ores, coal & minerals. This task occurs on a relatively small part of the 44 000 route-kilometres of the network—shown in Figure 1.2. These bulk flows are illustrated in Figure 1.3 and in Figure 1.4. Note that the volumes shown are indicative; if flows occur within an administrative area, the flows are not represented in the charts. As the figures show, most of this task is undertaken on a relatively small part of the network. The other significant flows (not illustrated) are the urban passenger flows in each of the mainland State capitals and the non-bulk freight flows between those capitals.

A feature of this network that illustrates harmonisation issues relevant to this study is that the network is dominated by three railway gauges: 1 067mm, 1 435mm and 1 600mm. Approximately 19 000 route-kilometres are laid to the narrow gauge, around 17 400 route-kilometres

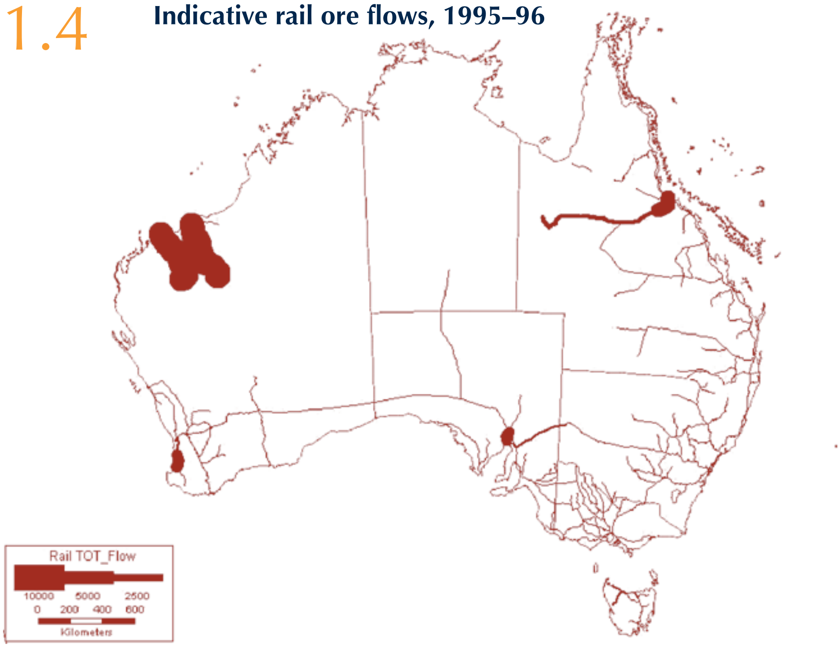
1.2 **Australian railway network**



1.3 Indicative rail coal flows, 1995–96



1.4 Indicative rail ore flows, 1995–96



Sources FDF Management (1998), BTRE estimates.

are laid to the 1 435mm ('standard') gauge and around 4 000 kilometres are laid to the broad gauge; and approximately 280 route-km are laid to more than one gauge (ARA 2003, p. 8, Figure 1.2).

Financial environment

It is important, in the context of this report, to understand the financial environment in which participants operate. Although private companies are willing to purchase track infrastructure, the underlying return on assets is often insufficient to warrant infrastructure renewal. Consequently, the companies are likely to pursue a strategy of depleting the assets acquired. As BTRE (2003b, p. 16) noted, where the commercial value of a line is low, 'a realistic commercial strategy is that such assets are allowed to become 'life-expired', i.e., they are not renewed'. In this context, a feature of railway infrastructure is that:

> The railways can continue to carry substantial volumes of freight in spite of a long period of underinvestment. The decline in the capital stock takes years to become obvious in the productivity and capacity of the railroad. (Conference Board of Canada 2001, p. 3)

In the case of Australian Government-owned Australian Rail Track Corporation (ARTC), the access charges are set at a rate that enables train operators to set competitive freight tariffs. This market-based rate is below the long-run cost base. The Australian Competition and Consumer Commission comments that:

> Existing charges set by ARTC in the marketplace result in revenues that fall significantly below a level that would allow for the business to earn an adequate long-term economic rate of return. (ACCC 2002, p. x)

This flat financial environment obviously has important implications for the number of projects that might merit greater technical standardisation. The muted commercial returns mean that an inefficient regulatory structure may have important effects on operators already working at the financial margins.

Trends in management and ownership

It is important, in the context of this review, to recognise how management of the publicly-built railway industry has changed fundamentally in the last decade. Ten years ago the system comprised five State-based integrated railways and a government-owned urban integrated operator

(TransAdelaide)—albeit with a degree of private suppliers of equipment. There are now considerably more industry participants and considerably greater private sector service provision. (See Figure 1.5.)

The primary participants in the industry are the:

- government-owned ARTC, as infrastructure manager of track between Parkeston, Melbourne and the Queensland border (excluding the Sydney metropolitan area);[3]
- privately-owned infrastructure manager Babcock & Brown (WestNet),[4] as infrastructure manager of infrastructure in the south-west of Western Australia;
- government-owned QR Network Access as infrastructure manager financially and managerially ring-fenced[5] from the parent (integrated) owner, QR;
- privately-owned Pacific National, Asia Pacific Transport Consortium, Genesee & Wyoming Australia and NRG [Flinders Power] as integrated railway operators;[6]
- privately-operated Connex and government-owned and operated TransAdelaide, Transperth and RailCorp as integrated urban passenger railway operators;

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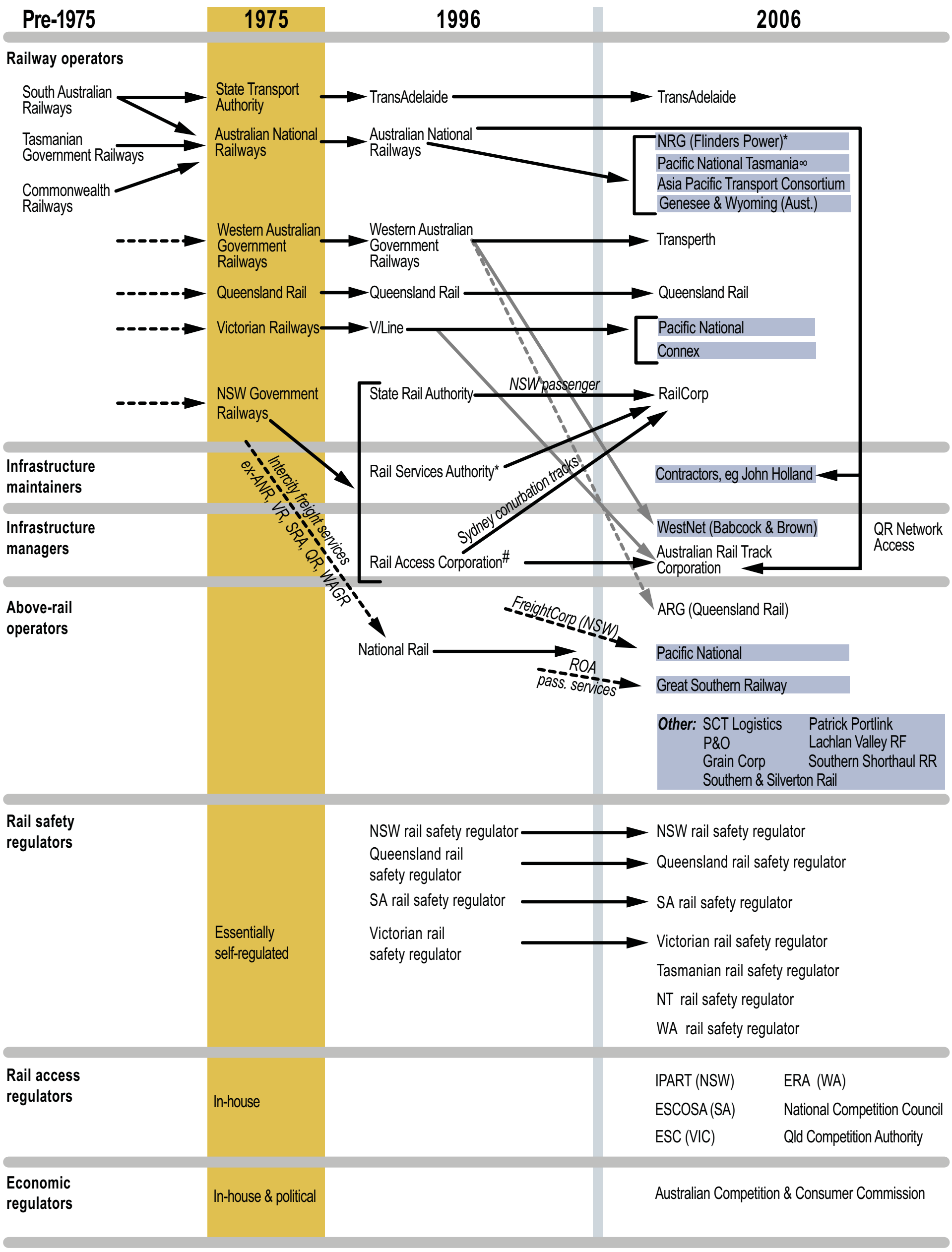
3 This includes management of leased secondary main line track in NSW, management of RIC's Country Regional Network and leasing of Sydney urban freight lines.

4 In June 2006, QR and Babcock & Brown took over assets of ARG. QR took over the train operations in WA and some of the train operations in SA and Babcock & Brown took over ARG's Western Australian ring-fenced below-rail assets-known as 'WestNet'. Genesee & Wyoming Australia made an outright purchase of most of ARG's railway operations in SA (including the hook-and-pull contract for freight services on the Darwin line. The establishment of the Babcock & Brown railway infrastructure provider is thought to be the first voluntary vertical railway separation of a private railway anywhere in the world.

5 ACCC defines 'ring-fencing' as being '...designed to assist the introduction of effective competition into markets traditionally supplied by natural monopolies. It involves putting structures into place to prevent flows of information and personnel, and inappropriate transferring of costs and revenues within an integrated utility and between related businesses' (ACCC web site, <http://www.accc.gov.au/gas/ring_fence/code_reqs_rf.htm>

6 In addition, there are privately-built railways, such as Pilbara Rail, BHP Iron Ore Railroad, Comalco Railway and Onesteel Railway. We do not consider these railways explicitly in this report.

1.5 Structure, ownership and regulation of public railways, 1975–2006



‡ Shaded entities are private companies * Pacific National is infrastructure manager for this line and also some NSW lines # Rail Infrastructure Corporation, 2001–2004

∞ It is proposed (2006) that Tasmanian track will revert to governement ownership and management (Tasports) with Pacific National Tasmania becoming an above-rail operator.

- Great Southern Railway as a private sector above-rail intercapital passenger train service provider, using contracted train operators' 'hook-and-pull' services;
- government-owned V/Line Passenger and Transwa as above-rail intrastate passenger train operators;
- government-owned QR National and privately-owned Pacific National, GrainCorp, Southern Shorthaul Railroad, Southern & Silverton Rail, Patrick Portlink, P&O and Lachlan Valley Rail Freight as above-rail freight operators;[7]
- privately-owned SCT Logistics (SCT) as a logistics freight forwarder, hiring train operators to 'hook-and-pull' their train;[8]
- general outsourcing of hitherto internal railway activities, including:
  - Chicago Freight Car Leasing Australia (CFCLA) as a rolling stock leasing provider;
  - Bradken Rail (and others) as rolling stock maintenance providers;
  - John Holland, Fluor and Transfield (and others) as infrastructure maintenance contractors to infrastructure managers.

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7 Given that work is often contracted out, definitions of railway operators can be somewhat ambiguous. As a consequence, we have interpreted the firm that takes the ultimate cost and revenue risk as being the 'operator'. Thus, NRG is described as the Leigh Creek operator even though Pacific National operates its trains under contract. Similarly, SCT Logistics takes the revenue risk on its trains even though Pacific National crew its trains.

8 SCT Logistics is the trading name of Twentieth Super Pace Nominees Pty Ltd. SCT takes the revenue risk for operating this train. By contrast, some major freight forwarders-such as QRX, a Queensland subsidiary of Toll-use common-carrier rail operations, paying for conveyance of wagons as used. That is, they do not bear the revenue risk for the train operation.

Over the same time period, National Rail was established, privatised and then absorbed within Pacific National. Australian National, WestRail and V/Line (freight) were also privatised.

As Booz Allen Hamilton have noted, a consequence of this diversification of responsibility and provision of services is that:

> Organisational interfaces have proliferated into interfaces between operators and track owners, between operators and between track owners, and with maintenance service providers. (Booz Allen Hamilton 1999, p. II-10)

The issue of organisational interfaces is discussed in more detail in Chapter 4, when we consider regulations.

Harmonisation trends

For simplicity, rail harmonisation issues can be considered in two broad categories: technical standards and regulatory standards. In this report, we consider those categories separately. Differences in technical standards across the network derive, in part, from the heritage of separate State—and Australian government-owned railways. Similarly, regulatory differences across the network have arisen from each government's oversight of the railway systems within each jurisdiction.

In the context of these parameters, there have been some notable developments in the national railway industry since Federation. These include:

- standardised rail gauge
- improved co-ordination on the rail system; and
- rolling stock harmonisation.

Standardised rail gauge

The Port Augusta–Kalgoorlie line was constructed in a new 'standard' gauge between 1912 and 1917. A standard-gauge railway was completed between northern New South Wales and Brisbane in 1930 and on the Melbourne–Albury route in 1962.[9] The following existing lines were converted to standard gauge:

- Kalgoorlie–Perth (1968)
- Broken Hill–Port Pirie (1970)
- Crystal Brook–Adelaide (1983); and
- Melbourne–Adelaide (1995).

Improved coordination on the railway system

Coordinated train operation

This horizontal integration of train services occurred in stages:

- From the 1960s, wagons could be 'through-worked' across borders. This was facilitated by Railways of Australia standards introduced at that time for wagons that were suitable for interchange across systems).[10]
- From the 1970s, interstate trains increasingly operated without changes of crews or locomotives at each railway's boundary.
- The incorporation, in 1991, of the national interstate rail freight company, National Rail Corporation—owned jointly by the Commonwealth, New South Wales and Victorian governments—led to central management of interstate trains. This replaced the system where the management, crewing and locomotion of interstate trains was essentially undertaken by each individual State operator.[11] From 1995, other operators (such as SCT Logistics and Patrick) provided similar trans-border services.

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9 This link formed part of what became known as the Wentworth Plan (named after the chairman of the Government Members' Rail Standardisation Committee that submitted a report on the standardisation of intercity railway gauges. The former Prime Minister, Mr Whitlam explained: 'A Liberal committee chaired by Wentworth and a Labor committee composed of Harrison and Webb, two railwaymen, and me tabled reports on 31 October 1956 with identical proposals for standard-gauge links between all the mainland capitals, including the links from both Perth and Adelaide to Sydney through Port Pirie and Broken Hill'. (Whitlam 1992).

10 Until the provision of common gauge links, chiefly since the 1960s, through-running across jurisdictional borders was not even a practical possibility.

11 National Rail (1999, p. 8) presents financial data showing the cost reductions achieved in moving from the coordinated State-based freight operations to the unitary National Rail operations.

Coordinated infrastructure management

Intercity railway management on the mainland has been strengthened through horizontal integration of infrastructure management. Two notable areas of development are:

- the Commonwealth taking over control of South Australia's interstate track in 1975;[12]
- the infrastructure manager, the ARTC, commencing management of some interstate track—including a lease on Victoria's interstate track in 1998 and lease of interstate track in New South Wales in 2004.

As well as enhancing train and infrastructure operations, these developments improve the ability to invest strategically and consistently across the intercity railway system.

Rolling stock harmonised

The National Rail Corporation introduced a standard fleet of locomotives ('NR' class) for its interstate traffic flows, replacing a range of different locomotives.[13]

Physical standards and management coordination of the national system have progressed—particularly since the mid-1990s. However, in the last decade, these advances have been offset by the introduction of regulations in each jurisdiction. These regulations have diverse, rather than coordinated, requirements. There is regulatory oversight for the structural form of each railway, the access regulations and pricing principles to which it must comply, and the safety management systems that it must have in place and abide by.

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12 In that year, the Commonwealth agreed to take over the (non-urban) South Australian Railways and the Tasmanian Government Railways, then merging these systems with the Commonwealth Railways to form Australian National Railways. The Industry Commission cites this policy as arising because the-then Prime Minister, Mr Whitlam '...considered that the administration of the railways by State governments had led to diseconomies such as duplication of facilities and administration, inefficient operating procedures, poor use of available resources, limited standardisation of equipment and a lack of a uniform approach to railway policy'. (Industry Commission 1991, p. 39)

13 National Rail reported that the commissioning of these locomotives brought about '...substantial reductions in train operating costs'. (National Rail 1999, p. 8)

Technical harmonisation

Australia shares the non-standardisation experiences of railway construction that occurred on other continents, and in individual countries, where railways were built to different rail gauges. Almost inevitably, lines of different gauges meet—where there is a break-of-gauge. Australian governments have invested substantial funds to remove gauge breaks. However, despite this, Australia's different gauges have persisted—typically this is far more so than other continents.

It is notable that, from the early days of the industry, States sometimes agreed on common technical standards. For instance, agreements arose following meetings of State railway commissioners to discuss consistency. There was impetus for such agreements even before the connection of State networks at borders highlighted the problems that can arise with different rail gauges. For example, to the extent that equipment was sourced with manufacturers outside of a State, there would have been cost advantages with supplying off-the-shelf (standard) equipment rather than bespoke (non-standard) equipment.

The concern with the gauge breaks, and the reason for investing to eliminate them, is that they result in significant costs in moving each wagon of goods across the gauges. These costs are known as 'bridging' (or 'gateway') costs. These costs arise because each wagon of goods (or each wagon's containers) normally has to be trans-shipped or the wagon's wheel-bogies swapped. This bridging activity is costly and lengthens delivery times. By way of illustration, Figure 1.6 shows how grain was transhipped by crane grabber between narrow gauge and broad gauge wagons at Gladstone in South Australia in 1980.

It is indisputable that the bridging cost per wagonload of goods is 'high'. This inhibits freight movements or leads to the freight being diverted to other modes. However, the consequences of such a non-standardisation depends on the actual or potential traffic flows. If these levels are modest, or low, the consequences of the remaining breaks are relatively minimal. This was the case in the early days of Australia's railways. At this time, the main freight flows were between the hinterland and the ports rather than between the colonies. This freight pattern still dominates traffic flows today. Nonetheless, with

1.6 **Transshipment of grain across railway gauges, Gladstone (SA) 1980**

the growth of single-market domestic trade flows following Federation, interstate flows have become increasingly important.

By the time that the first railways were being planned in Australian colonies, governments could observe the adverse effects of breaks of gauge in Britain. Despite this, the colonies built lines to differing standards. The operational consequences were realised from the 1880s as the different State-owned networks met at borders.[14] Colonial delegates at the Federal Convention of 1897 recognised the need for a uniform gauge. In the early years of Federation, the Commonwealth reviewed the issues with, for example, a 'Uniform railway gauge' report in 1911 and a Royal Commission in 1920–21.[15] In 1910, the State railway commissioners agreed that the 1 435mm gauge would be the uniform or 'standard' gauge.

14 In the case of South Australia, both narrow (1 067mm) and broad (1 600mm) gauge track were constructed. This led to the first mainland break of gauge, at Hamley Bridge.

15 See, for instance, Nayda, Adams and Hodgkinson (1984) for further details on standardisation plans.

The significant interstate freight task that came about due to the Second World War highlighted the gauge problems. After an interregnum following the passage of the *Railway Standardization Agreement Act* of 1946, major stages in the standardisation of railway gauge were achieved in 1962, 1969, 1983 and 1995. In 1995 the track work between Melbourne and Adelaide was completed. This was the last stage in the Wentworth Plan to link Brisbane and Perth via Broken Hill and Wolseley with a uniform gauge. This Melbourne–Adelaide investment—which saved time and money on bridging costs—was an important factor in the near-doubling in rail tonnage between the eastern States and Perth between 1994 and 2001 (BTRE 2003a, p. 4)

These rail investments have occurred against a background of growing interstate traffic flows and often more demanding service quality standards. The increased flows arose because of growth in the national economy and because State-centred economies have evolved into a single, nationally-focused, interdependent economy. The need for higher service quality standards occurred as shippers increasingly required just-in-time and seamless goods deliveries. These trends have, therefore, exposed the other infrastructure, operational and regulatory 'breaks-of-gauge' that exist across jurisdictions and railway networks. Road freight does not face comparable breaks. This gives it underlying competitive advantages in fulfilling transport requirements.

Thus, other reasons for the increased concern with rail harmonisation issues include:

- the introduction of through running of interstate trains, which has highlighted other physical and operational inconsistencies and has drawn attention to regulatory diversity and duplication;
- technical advances in infrastructure efficiency and train operations; and
- the adoption of mandated access policy—which has led operators to run over third-party infrastructure—and the associated vertical separation regulation.[16]

16 A vertically-integrated firm produces the various stages of production within the firm; a vertically-separated firm has a contract with other firms to provide parts of the production process. For instance, an integrated railway firm operates for-revenue trains and manages the track infrastructure; a vertically separated railway will manage the track but not operate for-revenue trains.

Regulatory harmonisation

It is noteworthy that harmonisation may also be impeded by mandated access—as part of National Competition Policy—and vertical separation regulation. The 1989 Federal Standing Committee report on the management of rail traffic on the east-west railway corridor acknowledged Australian National Railways' view that:

> ...the biggest single obstacle to greater efficiency was the fragmented management of the east-west corridor. It was pointed out that AN interacts directly with three other systems and to a lesser extent with a fourth. [AN advanced the cause for the ultimate] creation of single organisation to manage the national freight task. (House of Representatives Standing Committee on Transport, Communications and Infrastructure 1989, p. 21)

It is clear that that the mandated access and vertical separation policies have led to a substantial *increase* in the number of players and interfaces. That is, the policies have led to a *more* fragmented industry than when the Standing Committee report was written in 1989. This potentially further impedes harmonisation. Figure 1.5 illustrates the evolving structure of the publicly-built railways. It excludes privately-built lines such as those operated by OneSteel, BHP Billiton and Rio Tinto. To avoid oversimplifying this picture, readers should note that the traditional structure incorporated a degree of third-party service suppliers. It also included some trains operated exclusively for private firms—such as the regular TNT—commissioned train between Adelaide and Melbourne.

Changes in the structure in recent years include:

- vertical separations
  - ARTC and the outsourcing of traditional activities such as maintenance;
  - WestNet;[17]
  - Babcock & Brown
- horizontal separations

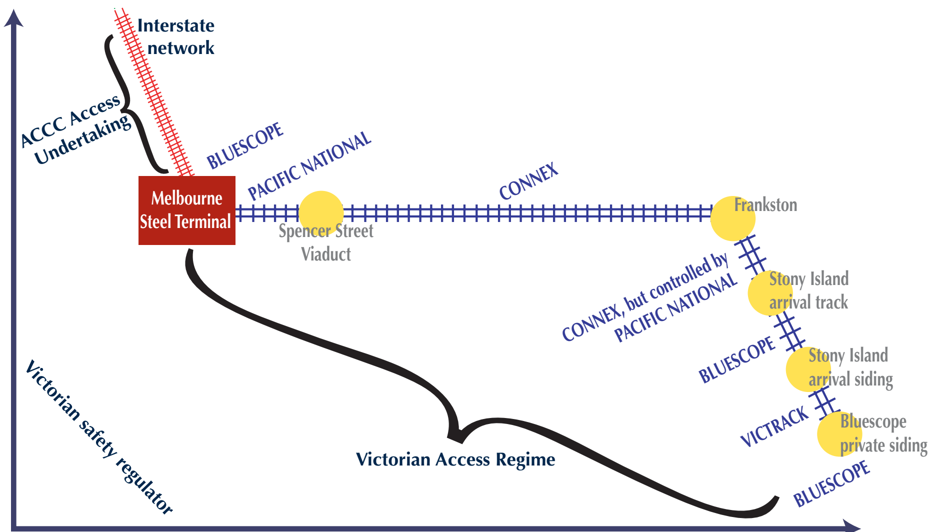
17 In February 2006 Babcock and Brown announced that it had acquired the ARG-WestNet ring-fenced below-rail asset operation of Australian Railroad Group.

  - urban/non-urban splits—TransAdelaide, Transperth, Connex, RailCorp
  - geographical splits—for example, Australian National track now managed in three segments: NRG, Genesee & Wyoming Australia and Pacific National Tasmania; Victorian track is also managed in three segments: ARTC [interstate], Connex [Melbourne passenger] and Pacific National [urban freight and country intrastate]
  - geographical amalgamations—interstate freights (NR/PN) and ARTC infrastructure management extended over Victorian and New South Wales track;
- the shift from safety self-regulation to part-external safety regulation;
- single-user railway operation to third-party/open access;
- access regulators;
- pricing regulators—instead of internal regulation and/or political sanction of tariff levels;[18] and
- change of ownership of railways from purely-public ownership to a mixture of public and private.

Each interface between industry participants brings costs—legal, contractual and safety as well as transaction and opportunity costs. Ultimately, however, those fragmentation costs arising from additional interfaces need to be set against any benefits from increased competition that derive from this fragmentation. Figure 1.7 illustrates how the different infrastructure management, technical and regulatory interfaces can overlay the operation of a train. In this case, we show the interfaces for a steel train moving between the interstate standard gauge network and Westernport on the broad gauge, which involves transshipment of the goods at the Melbourne Steel Terminal. The range of other technical standards, such as different signalling and communications systems used along the journey, is not shown in the diagram. The train passes over several different infrastructure

18 See Industry Commission (1991, pp. 40-42) and Fitch (2002, *passim.*) for a discussion on governments' role in tariff-setting and railway standards and construction.

1.7 Illustration of infrastructure management, technical and regulatory interfaces



Illustrative infrastructure management and regulation
Steel movements between Melbourne Steel Terminal and Westernport approx 75km—links not to scale

managers, two access regimes and is overseen, in this case, by the Victorian safety regime.

The new industry structure has moved from self-regulation of safety to a co-regulated model, including new government safety regulators.[19] The structure includes infrastructure managers who are ring-fenced or vertically-separated from train operations, new access regulators and regulations on setting terms of access.

As noted earlier, harmonisation refers to regulatory, as well as physical, issues. In the year after a uniform intercity gauge was finally achieved, a process began in which sometimes-inconsistent access, structural and accreditation regulations were introduced by each jurisdiction. This is significant. An issue for this report is the degree to which these inconsistencies are sub-optimal. In particular, they

19 Terms of 'self-regulation' and 'co-regulation' are defined in the Glossary.

could potentially form regulatory breaks-of-gauge, affecting the viability and competitiveness of the industry.

Concepts

Before considering harmonisation, we need to consider what it is that may need to be harmonised and, indeed, what is meant by harmonisation.

Defining areas of standards

The issues of harmonisation may be identified in three categories:

- physical (or technical) standards;
- operating (or working practice) standards; and
- regulatory standards.

In practice, however, these categories are interlinked. Physical standards strongly influence the operating procedures that are needed. Operating procedures are strongly linked to safety regulations: the procedures adopted influence the nature of safety oversight.

The safety and operating systems cover common issues. Railway operators' operating systems complement *and* follow regulations and principles outlined by safety regulators. An example of the inter-linkage is given by the operational principles in Victoria:

> In Victoria, compliance with operational safety over the three rail networks is managed through the PTC Rule Book 1992 and to a lesser degree, through the NCOPs [National Code of Practice]. Compliance with the Rule Book and the NCOP is required by the Track Managers as a condition of access to their networks. The Rule Book and NCOPs are supplemented by rules and procedure manuals developed by individual operators. (DOI 2004, p. 62)

In this case, it can be seen that the operators' and infrastructure managers' operating procedures is linked to regulatory oversight. The boundary between the self-management and the oversight reflects the 'co-regulatory' nature of safety. Thus, it is difficult to consider operating practices and regulatory standards independently because of this blurred boundary between the operating standards and safety regulatory oversight. For this reason, in this report we consider the areas of operating standards and (safety) regulatory standards together.

Concepts of 'harmonisation'

Three degrees of 'harmonisation' are considered in the report[20]:

- There are the common systems or 'standards', such as where there is a common distance (gauge) between the rails on the track.
- There is *compatibility* between systems, where systems are different but can be linked by an interface. This enables a part of a system to be incorporated into a larger system. For example, different railways may have different freight tracking software. However, it may be possible to write a software bridge, or interface, between the different data systems, thereby eliminating the need to retype the data.
- There is the use of *protocol*. This sets a common, generally low, level of technical compatibility between systems enabling the development of interoperable systems.

In this context, standardisation is a subset of harmonisation. In this report, we use the terms 'harmonisation' and 'standards' interchangeably while recognising, and considering, where compatibility and protocols are also possible solutions for harmonisation.

There may be cases where harmonisation is not ideal. There is a counter-balance to harmonisation, which is variously described as 'flexibility', 'fit-for-purpose', 'customisation' or differential standards, recognising that one-size does not necessarily fit-all. On a national network, geography, demographics, safety considerations[21] or task differ significantly. These differences can create important operational efficiency practicalities and financial considerations as to why standards used on one part of the network are not appropriate

20 In their literature review, David and Greenstein (1990) provide a related set of standards definitions: 'reference, minimum quality, and interface or "compatibility" standards' (p. 4). As the authors note, when reference standards are adhered to, they reduce transaction costs of user evaluation.

21 ... or 'risk'.

elsewhere on the network. For example, an investment appraisal may conclude that a higher standard is warranted on one part of the system than on another part of the system. Non-standard specifications may be desirable when non-standardisation captures benefits of systems tailored to location-specific train, track and traffic economics. This case for tailored specification is further strengthened where the bridging costs of non-standardisation are low (due to low unit bridging costs and/or low bridging flows).

Assessing the optimal level of harmonisation

The report identifies the principal forms of physical disparity on the network. Physical disparities can impose pinch points or capacity constraints and higher operating costs and lower efficiency—both of infrastructure management and train operation. These disparities can impose costs on the network. In the case of railways, the width of the rail gauge is the most well-known disparity.

Nonetheless, we should also acknowledge that the observed differences can be consistent with geographical, historical and train/track operational needs. That is, 'optimal' harmonisation can include situations where standards vary because it is more cost-effective or because it is more operationally-efficient. Adopting, and investing in, common standards may lead to greater ongoing operational costs. These increased costs can outweigh the potential operational benefits of consistency. Where the efficiency gains from harmonisation are relatively low, the need to recover the investment costs through access charges and freight tariffs may then reduce rail's competitiveness. For example, European Union directives seek to require railway companies to adopt a standard European train control system ('ERTMS'). The German operator, Deutsche Bahn, has warned that this would lead to 'higher [consequent operating] costs [to repay the investment costs, which would] damage the transfer of traffic from road to rail' (Railway Gazette International 2004, p. 16). More generally, Dodgson argues that 'there is too much concern about interoperability—which could end up imposing enormous costs' while also noting that there is 'too little concern about whether benefits of individual proposals outweigh the costs' (Dodgson 2004, p. 27).

A key question that arises from this is to ask how important harmonisation is—what costs arise from sub-optimal harmonisation—or what *benefits* flow from increased harmonisation? Quantifying the magnitude of the issue would obviously help us to understand how serious it is.

But is it possible to make such an assessment? NERA was commissioned to examine European safety regulations and standards and consider the benefits that could arise from harmonising these regulations and standards. It stressed the importance of estimating the costs and benefits of individual projects designed to generate interoperability, harmonisation or compatibility. Nonetheless, it advanced caution about undertaking an exercise that would generate a monetary estimate of the net benefits of harmonisation *at a network level*. It concluded that:

> We have considered this carefully, but conclude that these are not issues which can be quantified reliably at such a general level... Reliable analytical quantification of the *total* costs of regulation or the benefits of harmonisation is not however possible, ex ante, for several reasons. One reason is that there is no clearly definable aggregate set of alternatives to compare. No "harmonised" world can usefully be defined in the abstract. ...Another reason is that the benefits of harmonisation can be measured only very partially in engineering terms. The main benefits will probably be in terms of greater flexibility and more competition, leading to a generally more dynamic and efficient railway. But this cannot be reliably quantified. (NERA 2000, p. 101)

In this context we should note that these network-based aggregate benefits are often very nebulous and uncertain. This naturally, and correctly, works against cost-benefit analyses of network-wide physical harmonisation schemes. In particular, the analyses will set relatively precise cost, or engineering-based, estimates for the early years of a harmonisation project against very uncertain benefits accruing in much later years. For a correctly applied cost-benefit analysis, therefore, there will naturally be an inherent aversion to such high risk ventures. More generally, NERA warn against such analysis, concluding that:

> For an aggregate calculation of thousands of extraordinarily diverse and uncertain measures such estimates would become unrealistic. (NERA 2000, p. 102)

NERA also notes the difficulty of undertaking *partial* cost-benefit analyses of harmonisation-driven projects. For example, it notes the difficulty it had distinguishing between the benefits arising from safety enhancement and those arising from more general operational harmonisation. Similarly, it is difficult to distinguish the effects of harmonisation, 'uniformity', from those that simply arise more generally from any investment. Taken to its extreme, Allen Consulting concluded that harmonisation as an issue in Australia is often a misnomer—the real issue is 'investment'[22]:

> ...in most cases, it is not the uniformity of the infrastructure that is the issue (or lack thereof) but the state or capacity of the existing infrastructure, and this is an issue primarily related to investment. (Allen Consulting 2001, p. 46)

For example, the Australian Rail Track Corporation Audit identifies major areas of rail infrastructure investment on the intercity network. The audit assesses the benefits and costs of infrastructure upgrading—which is often a form of infrastructure harmonisation. For instance, track renewals can incorporate enhanced (heavier or harder) rails, which widens the rail network that is capable of heavier axle loads.

As a consequence of these measurement and interpretation issues, this study does not seek to estimate the costs of the degree of sub-optimality in the current operational and regulatory harmonisation.

Overview of harmonisation areas

The railway industry has considerable diversity in infrastructure, operating systems and regulatory oversight. This report considers harmonisation separately for two broad aspects of the railway environment, 'infrastructure' and 'regulation'.

As can be seen in Figure 1.8, the railway operating framework is set by physical inputs and the regulatory environment. The physical inputs are the track and the train while the regulatory environment comprises industry self-regulation or externally-enforced government regulations. Variations in specifications may be optimal solutions—tailored to the specific traffic or geography. Despite this, train

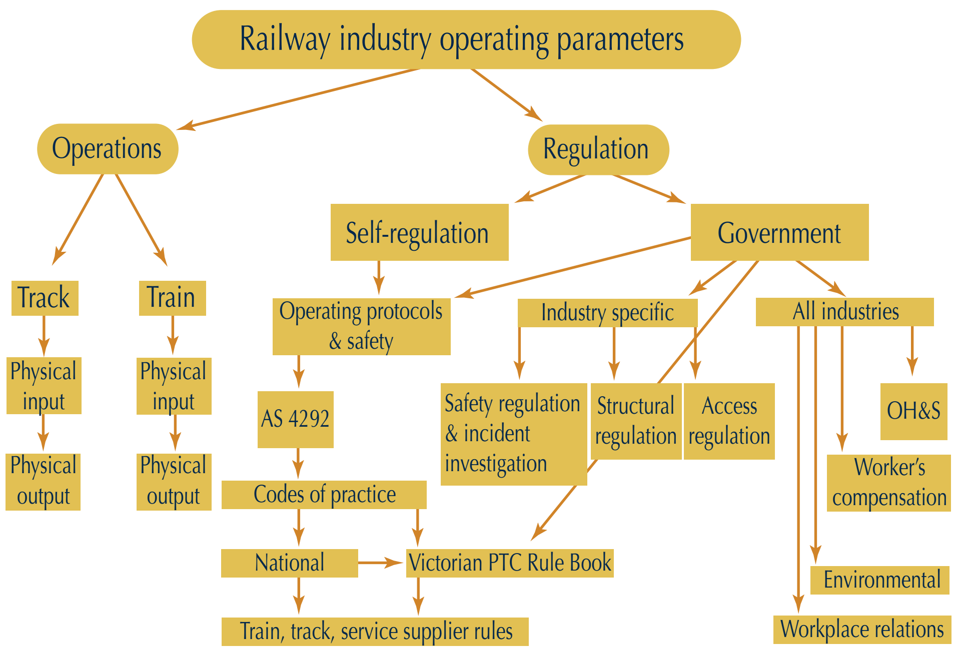
22 Indeed, as noted below (page 49), harmonisation costs can be relatively low compared to the infrastructure enhancement and renewal costs that are often bundled with it.

inconsistencies, such as incompatible wagons and locomotives, may restrict operational flexibility—that is, how the train is formed and where the rolling stock can move. Similarly; track inconsistencies lead to variable train speeds, train lengths and wagon weight limits.

We recognise that diversity in regulation oversight may be optimal, reflecting local physical or operational factors. However, regulatory inconsistencies can also impact adversely on railways. As Figure 1.8 illustrates, railways have a degree of self-regulation in operations, including safety processes, but these regulations vary across industry players. Similarly, external, that is, government, regulations are applied. Two categories of such regulations are:

- those that apply to all industries—such as Occupational Health & Safety, OH&S—regulations); and
- industry-specific regulations—such as mandated access regulation.

1.8 Railways' operational and regulatory framework



These regulations vary across jurisdictions and the inconsistencies between them may impact adversely on operating efficiency, competition and investment.

In essence, then, a non-optimal operating environment as a result of the operational and regulatory framework used will result in pinch-points or capacity constraints and in lower efficiency. This, in turn, will lead to higher operating costs.

Infrastructure

Infrastructure includes all physical aspects of railway operation. One approach to looking at the physical aspects is to look at the differences in the physical dimensions—the physical inputs. Major physical areas where there is an absence of harmonisation include:

- different railway gauges;
- different loading outlines;[23] and
- different forms of signals and telecommunications.

Another approach to considering the physical disharmony is to look at the physical outputs—how the railway can be utilised. Thus, a consequence of the differences in inputs can be differences in

- train speeds;
- axle loads; and
- permitted wagon sizes across the network.

These differences relate to how the infrastructure is used. In some cases, the differences can limit the extent to which the infrastructure is used—notably, due to differences in railway gauge.

The foregoing has concentrated on the 'below-rail', (track infrastructure) physical differences. There are above-rail differences in trains—locomotives, wagons and carriages. In some cases, these differences mirror the differences in the below-rail infrastructure—again, notably, rolling stock that has wheel sets for a given railway

23 The loading outline specifies the maximum height and width specifications that a rail vehicle must comply in order to operate over a given railway track.

gauge. For example, without changing bogies, it is not generally possible for the stock to move across gauges. Similarly, it is not normally possible for electrically-powered stock to operate on non-electrified sections of track. One area of above-rail disharmony arises from technical differences in locomotive power configurations. Often, these differences are relatively minor but nonetheless, for completeness, the differences need to be considered.

One other important area of infrastructure standardisation is in ancillary activities. These include physical components used in the industry—such as locomotive and rolling stock parts—and the development of a largely-universal suite of freight containers that are suitable for movement by rail, road, sea and air. Given the extensive and detailed issues here, the authors intend only to acknowledge these issues.

Regulation

Regulation is the other primary harmonisation area. Here there are regulatory inconsistencies, which are exacerbated due to an environment of significant degrees of regulatory duplication. This issue applies to self-regulation as well as government regulation. Inconsistent regulations can, therefore, lead to differences in train control and conduct across government jurisdictions and across train and track operators. These differences may, in turn, result in differences in operator accreditation, mandated access, economic regulation, and in safety and operating protocols.

Other significant regulatory areas are structural regulation and access regulation. Commonwealth-owned and managed railways are vertically separated. That is, track management is separate from revenue-earning train operation. In Queensland and Western Australia there are vertically-integrated operations with ring-fenced infrastructure managers (and this structure is also planned for Victoria). In South Australia and Tasmania there are vertically-integrated operators without ring-fenced infrastructure managers. Incremental costs arise from separation[24] but it enhances the

24 Thompson (2005, p. 421) notes that '...vertical separation creates specific issues, particularly transaction costs among operators and infrastructure, co-ordination and safety costs of split operation, and the need to develop access charges that raise the desired amounts of user fees without seriously distorting traffic in total or among classes of users. In short, there is no "one size fits all" approach available'.

competitive environment—and so the benefits derived from competition. If traffic levels are low, the potential for competition is low. Consequently, it could be argued that separation be undertaken only where there are reasonable prospects of competition. However, while we recognise that diverse structures could be optimal, States with similar traffic patterns—notably NSW and Queensland—have regulated their structures differently.

Each jurisdiction also has its own access regulation and different access charging principles that are used by the respective infrastructure managers. The variation in access regulations can reflect, in part, the differences in structural regulation. Again, the authors note that diversity is not necessarily sub-optimal. Different pricing systems may reflect different train and infrastructure characteristics on a network. However, where differences are not optimal, they add transaction costs to train operators to use the network and send conflicting signals in how the track should be used and invested in.

Recent developments in harmonisation

This section provides an overview of developments in physical and regulatory harmonisation in Australia.

We should preface this overview by noting that the establishment of National Rail and Australian Rail Track Corporation are not, in themselves, 'harmonisation developments' in the physical and regulatory system. Nonetheless, these cross-border entities can be important driving forces for optimising standards and regulatory oversight.

Infrastructure

The introduction to this chapter noted that harmonisation of track gauge on the intercity network was completed in 1995. This section discusses other areas of development.

Codes of Practice on technical standards

A significant initiative in 2000 was the establishment and subsequent activities of the Australian Rail Operations Unit (AROU), formed within the Australian Government's Department of Transport &

Regional Services. The Unit's primary role has been to facilitate the development and implementation of the Code of Practice of technical standards and procedures. The Code builds upon earlier standards and procedures developed by Railways of Australia. This, in turn, used some frameworks and standards developed by the Association of American Railroads.

Application of the Code, by industry members, is voluntary, not mandated. The Code is intended to instil a national (that is, harmonised) approach to operational and engineering practices. In July 2003, ownership of the Code was transferred from the Commonwealth to the Code Management Company. The company is a subsidiary of the Australasian Railway Association (ARA)—the primary public voice for the industry in Australasia. The company will manage and further develop the Code.

Communications

The Department of Transport & Regional Services, with the National Transport Commission, commissioned a study on rail communications. The work was undertaken by Booz Allen & Hamilton (BAH 2003), which found that there were multiple communications systems, with little interoperability and compatibility. As a result, operators had to acquire and maintain multiple communications equipment, maintain detailed radio frequency data and train staff in these different systems (BAH 2003, p. 4). BAH recommended that a cost-benefit analysis be undertaken of the options for either a single technology system across the network or multiple, but interoperable, rail communications systems (BAH 2003, pp. 7, 43).

Loading outline/clearance

The Department of Infrastructure (Victoria) commissioned a study into the benefits of harmonising the main lines in south-eastern Australia to a loading outline, (that is a clearance), that would permit double stacking. All of the options assessed by the consultants gave benefit estimates that were less than the costs of investing in enlarging clearance (Maunsell 2003).

Regulations

An important aspect of railway regulations is the federal structure. The Australian, State and Territory governments each have power to regulate in three major areas of the railway business: structural form, access and safety (accreditation) regulations.

Structural regulation

Until recently, Australia's government-owned railway operations were structured as vertically integrated businesses. That is, trains and infrastructure managed were within the same organisation. This has changed for two jurisdictions. In 1996 the NSW government separated the railway system into an above-rail train operating business and below-rail infrastructure maintenance and management businesses. In 2004, the urban part of the system was partially re-integrated, with RailCorp being responsible for urban railway infrastructure and passenger trains. In 1998, ARTC commenced operation as a below-rail infrastructure manager of the Commonwealth's rail infrastructure and the Victorian interstate track.[25] In 2006, Babcock and Brown bought Australian Railroad Group's ring-fenced Western Australian infrastructure manager, WestNet.[26] This created Australia's second vertically-separated infrastructure manager.

Other jurisdictions have not replicated the structural regulation. Other government-owned, or former government-owned, infrastructure remains 'vertically integrated'. Queensland Rail has a ring-fenced infrastructure managers—QR Network Access.

There are no plans to harmonise the structural form.

Mandated access regulation

Following Australian governments' Inter-Governmental Agreement on National Competition Policy in 1995, State, Territory and Commonwealth regulators have established mandated access to rail infrastructure.[27]

However, the regulations and principles for access differ across jurisdictions. Recognising this inconsistency, in February 2006, the Council of Australian Governments signed a Competition and

25 In addition, from 2004 it has leased interstate and some secondary lines in NSW.

26 This acquisition was subject to regulatory approval by the ACCC, which was given in March 2006.

27 The fact that access was mandated had not necessarily prevented the operation of privately-owned trains on public track-such as in Queensland. See Industry Commission 1991, p. 43.

Infrastructure Reform Agreement, albeit that it would not encompass all railways. The Agreement is:

> ...a simpler and consistent national system of rail access regulation for *agreed nationally signficant railways* using the Australian Rail Track Corporation access undertaking as a model. [emphasis added] (COAG 2006)

In terms of interstate operations, it might be argued that ARTC's regulated terms of access—as approved by the Australian Competition and Consumer Commission, ACCC—provides a benchmark. Indeed, Freight Australia sought to have the Victorian regime modelled on it but this was rejected by the relevant regulator, National Competition Council (NCC).[28]

Safety regulation and accreditation

Historically, the railway system was essentially self-regulated. The establishment of mandated access principles made it essential to move beyond this. This was because, reformers recognised that, with third-party operators and increased use of contracting-out of activities, a new formal *external* umbrella of safety processes was needed.

Safety regulation focuses on accrediting, or licensing, railway operators and contractors. Jurisdictions introduced accreditation systems from the mid-1990s. A system of 'co-regulation' was established. It was based on the principle that each entity—government, train, track or other railway—should control the risk that it was in the best position to manage. (See the Glossary for a formal definition of co-regulation.)

Governments recognised that safety and accreditation processes and principles should be harmonised. Yet differences arose from the outset. A high-level group within the Australian Transport Council (ATC) subsequently worked on a process where train operators would receive mutual recognition of their operating credentials across jurisdictions. More recently, the National Transport Commission (NTC) investigated ways to improve and strengthen co-regulation and mutual recognition.

28 It is unclear why Freight Australia sought to use the ARTC access 'model', although an attribute of the agreed undertaking is that return on capital is considered explicitly. This was an area of contention between Freight Australia and the Victorian government in setting access charges with (for various reasons) the Victorian government excluding a return on 'historical' assets (assets prior to the sale of Freight Victoria to RailAmerica) being excluded from the asset base being used to establish a financial return.

In November 2004, at the ATC meeting, the transport ministers endorsed a package of reforms to accreditation. These reforms are intended to streamline the process—notably through having more consistent guidance and the application of processes for risk and safety management systems. Ministers have agreed to develop a joint national rail accreditation system with the following principles:

- provision of a one-stop-shop approach to accreditation;
- availability to all industry participants operating across borders or within multiple jurisdictions; and
- payment of a single fee, calculated with a common and transparent methodology.

The NTC drafted model safety legislation, the Rail Safety (Reform) Bill; in June 2006, this Bill and an associated package of reforms was approved by Australian transport ministers. Once implemented, the package will have a '…nationally consistent legislative framework for rail safety' (ATC 2006).

In addition, the NTC has developed a National Standard for Health Assessment of Rail Safety Workers. The standard sets out a national policy on key safety issues—such as fatigue, drug and alcohol testing and medical fitness of safety-critical rail workers. The standard was endorsed by all transport ministers at an ATC meeting in 2004 and was adopted by all jurisdictions.

Concluding comment

In recent years, there have been considerable developments in rail harmonisation. These developments reflect—but arguably lag behind—the growing interstate trade flows as well as the growth in export-based bulk haulage between the hinterland and the port.

Has the physical and regulatory environment been optimally harmonised? Are there market impediments to achieving that optimisation? What are the consequences of sub-optimal harmonisation? These are the primary issues addressed in Chapter 2.

Chapter 2

Achieving optimal harmonisation

Summary

This chapter reviews the principles of harmonisation and considers the role of government in achieving optimal harmonisation.

Harmonisation may deliver benefits such as lower input costs, improvements in operational efficiency, higher inherent safety and lower training costs and access to a wider market. However, diverse or customised systems can be more efficient than standardised systems, notably where there are varying market or geographical operating environments or varying financial and safety risks.

The merits of customisation relative to harmonisation depends on the benefits arising from having that diversity and the bridging costs that arise in linking diverse systems.

Optimal harmonisation necessarily reflects the inherited standards-that is, the strategy is 'path dependent' on the historical decisions. This is important for Australia's railways, with a history of local, independent, decisions on standards, long-lived infrastructure and low returns on investment. This means that optimal harmonisation in the industry is highly unlikely to lead to early asset replacement.

Commercial pressures will not necessarily bring about optimal harmonisation. A sub-optimal outcome in standard-setting and standard-adoption can arise due to market failure and market imperfections. However, sub-optimality is less likely where financial inter-dependence between industry players is relatively strong, as with network industries. Sub-optimality can also arise if the benefits and costs of harmonisation fall unevenly across industry players. However, if in aggregate there are significant gains from greater harmonisation, we might expect that major beneficiaries will have the incentives to share their disproportionate benefits with those parties that bear a disproportionate share of the costs. This negotiating task is relatively easier to achieve when there are relatively few industry players, as in Australia's rail industry.

Government can intervene to set and enforce the adoption of physical standards when it perceives sub-optimality. However, while government has that fiat, it does not necessarily have the superior knowledge to identify appropriate standards; thus, the intervention could worsen rather than enhance welfare. This outcome is less likely where the government intervenes with a co-ordination or facilitation role.

Most Australian railways were government-owned and operated until recent years; they were also based around separate federal and State jurisdictions. Thus, commercial pressures were muted (and political influences stronger), with decisions being made by sovereign governments. Further, in the past the national economy had reflected aggregation of intra-State activities rather than a cohesive interaction between the States and interstate flows were relatively unimportant. Thus, the federal structure of decision-making, the muted commercial pressures and the relatively small interstate traffic flows acted against the industry developing a greater degree of harmonisation, the legacy of which remains today. The commercialisation/privatisation of the railways and the growth in interstate traffic provide greater pressure for, and benefits from, increased harmonisation. Despite privatisation of much of the industry, regulations are still developed and applied by each jurisdiction, meaning that consistency is not guaranteed.

Background

In this chapter we outline the benefits of harmonisation. From this we consider what 'optimal' harmonisation is. We then consider whether, for standards in general, and the railway industry in particular, the market will choose the right standard and then optimise the application of that standard. Finally, we outline the case for government intervention in optimising harmonisation, based on the fundamental questions:

- what is it that leads to sub-optimal harmonisation?
- if net benefits are demonstrable, what form of government intervention should be undertaken?
- will the benefits of government intervention to correct any market failure outweigh the costs?

Benefits and costs of harmonisation

Benefits

For goods in general, including the railway industry, the benefits of harmonisation can be broadly classified into

- input cost savings;
- operational (efficiency) benefits;
- safety and training; and
- market forces benefits.

These benefits are now discussed.

As Table 2.1 illustrates, product standardisation occurs for several beneficial reasons. These include:

- Interoperability. A primary benefit of standardisation relates to interoperability. This is especially relevant for network industries such as railways—being able to operate across different systems or geographical jurisdictions without technical barriers.

- Conveying information. Standards can convey a given, consistent quality. This reduces uncertainty. Similarly, by providing consistency in conveying information, such as with standard signage, this improves cognition and reduces confusion. In the railway context, consistency in conveying information enhances safety.
- Stockholding. With standardisation of equipment, users—consumers and manufacturers—benefit by reducing stockholding. For example, avoiding instances such as never having the right battery size or access to the appropriate grade of petrol.

2.1 Product standardisation, by origin of standard-setting

	Function			
Creation process	*Interoperability*	*Minimum quality**	*Variety reduction*	*Information*
Standards produced by the unaided market (De facto)	Microsoft Windows	Hotel star ratings	VHS video tape	Recycling data
Voluntary consensus standard	The size of paper stationery (A4 etc.)	Cycle lighting	Dry battery sizes	Signs designating public lavatories
Regulatory	Reporting procedures for company accounts	Safety of toys	Petrol grades	International road signs

Source: Temple and Williams 2002, p. 15.

Note: * Quality standardisation can assist consumers when faced with the market failure consequences of asymmetric information. Branded goods such as McDonalds hamburgers set a highly-controlled consistent product output that allows consumers to buy products with minimal search information required.

Many of these standards have come about through de facto adoption of compatible equipment or through voluntary consensus.

In some cases the government intervenes in the standard-setting process because particular industry players set specific standards to benefit themselves at the expense of competitors. This is why the German rules for standardisation require full participation from all parties that have an interest in the results of that standardisation. The Germans consider that if attendance and participation are limited, the law regards the parties as a cartel. That is, a body seeking to 'fix' the degree of competition in the market (European Commission 1999, p. 36).

In the following discussion we consider the primary commercial drivers that would seek to optimise standardisation without intervention.

Input costs

Where there is input standardisation or compatibility, a firm's input costs may fall because components are substitutable. This can apply to both physical capital and labour. In the latter case, for example, training costs are lower and there is a greater pool of labour. Thus, broadening the market for inputs may reduce the per-unit input cost.

It might be presumed that individual railways normally seek to standardise their components with other operators. One benefit is that the companies then have access to a broader and deeper market for those components. For example, Puffert (1996) observes that even the mining railways in Australia and Africa, isolated from the main network, have adopted the Scottish, or 'standard', gauge, 'arguably due to the [wider] market for equipment'. Equally, potential consumers of a type of product will 'increase their valuations for the basic product, expanding the market' if standards are identical or if there is technical compatibility—through common interfaces or adaptors (Berg 1989, p. 32). A related benefit is that firms have lower transaction costs arising from drawing up contractual agreements to supply goods to a known, common specification.

Operational efficiency

In essence, a fundamental presumed benefit of harmonisation for railways is that it enhances their ability to operate trains seamlessly over the entire network. Benefits accrue in several areas, as described below:

Service quality

Harmonisation can significantly improve the standard of service that can be supplied to customers. This can include reducing journey times and increasing the punctuality and reliability of services. These improvements can improve rail's competitive edge relative to road and thereby enable it to gain traffic.

Railway economics

Often, the full potential of sections of track, laid to a high standard, cannot be exploited until lower standards on other sections of track are raised. Thus, the benefit of harmonisation can be to unlock the potential railway economics that exist where higher standards are already in place. An example of this is when track sections that have relatively low axle loads and loading outlines are upgraded. This can unlock the potential operational efficiency gains that are achievable due to the higher track standards found elsewhere on the network.

Equipment utilisation and stocks

Harmonisation can lead to substantial savings in equipment costs. Fewer sets of hardware are required and the cost of spare parts is reduced. It also increases the flexibility with which the hardware is applied. For example, locomotives and rolling stock may be restricted to certain routes due to rail or bridge weight restrictions on other routes.

Safety and training

Operational harmonisation can enhance safety through a consistent approach. In the Australian rail industry, there are multiple operating practices across the network. Workers and equipment need to adapt to different practices when moving across the network. This creates the potential for confusion. Additional cost is also incurred in training workers for each operating system. Operational and training systems may need to differ in specific situations—notably, in urban areas where train control systems are necessarily more sophisticated. However, where there are similar operational environments, *consistent* systems will, by reducing the chance for confusion, be inherently safer and reduce training costs.

Market

Harmonisation assists the market for goods in two different ways. First, harmonised systems provide benefits to network users, who benefit from being linked to a larger number of consumers. For instance, adopting a standard railway gauge and increasing the warehouses linked on that network confers benefits to all network users—users on the system can interact directly with others on the system.[29]

Harmonisation also increases market competition. For example, in the rail industry, harmonisation reduces the entry barriers that operators would otherwise face in moving over parts of the system. This facilitates competition. Another example is the European Union's plan to develop telecommunications equipment standardisation. This reflects the greater cross-border communication flows and recognises the benefits that would flow from strong competition in the equipment market (Greenstein 1992, p. 546).

Costs

The apparent benefits from harmonisation or standardisation might imply that such actions are always beneficial and, therefore, something that should be encouraged. However, a critical issue is that the costs may outweigh the ensuing benefits. This is particularly relevant when the action arises from government intervention rather than an industry initiative.

There are several areas where imposing common standards may increase operation costs. These are now considered.

Efficiency decline from loss of customisation

Economic investment appraisals evaluate the costs and benefits of different construction and design options. For railways, in particular, there are large up-front construction costs and a long stream of uncertain benefits (the traffic-revenue stream). In this environment, there is a very significant risk that imposing a higher standard will make it uneconomic (or financially unviable) to proceed, or to continue, with a given rail operation. Thus, adopting lower standards[30] can reflect other relevant factors that influence the final decision. These factors include project risks, the topography—which may involve relatively high construction costs—the modest traffic-revenue projections and the need for an up-front revenue stream.

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29 Note, however, that although the market does not recognise these 'externality' benefits, this does not constitute 'market failure' because they are pecuniary externalities that accrue to users. See Liebowitz & Margolis (1995).

30 or, potentially, a higher standard.

There is the potential for co-existing differential standards to be optimal. The rationale for constructing inconsistent railway gauges illustrates where differentiation may be financially preferable to consistency. It may, of course, be that at the time of an investment there was no 'standard', as such. Even if there is a standard, Berg cites the construction of narrow gauge railways; here, he argues, substantial *construction* savings could be made by using the smaller gauge—'the incompatibility may be least-cost for the system' (Berg 1989, p. 33). Also, if the degree or costs of trans-shipment across gauges are low, then incompatibility with other parts of a 'network' may be an optimal specification.

The risk in standard-setting is that in different parts of the network the standard is inadequate or excessive (in nature and cost), relative to the geographic, operational and traffic needs.[31] Inappropriate compatibility and harmonisation can generate additional costs for maintaining and using a network. Thus, standardised infrastructure can generate some benefits but higher costs, which include the:

- capital costs of standardisation;
- opportunity costs of the application of the funds;
- higher operating costs; and
- efficiency losses arising if the adopted standard is inferior.

In any case, a non-standard technology may have characteristics that are preferred by some users but not by others. That is, the displaced technology may be a preferred solution in some situations. More generally, Casella argues that:

> ...because the cost of standardization is, by definition, the decline in variety and because different firms may well prefer different standards, it is not *a priori* obvious that the optimal number of standards is a single one (Casella 1996, p. 3).

31 Highly-trafficked USA railways have adopted high-standard trackwork that is inconsistent with low-trafficked lines. USA's major ('Class I') railways are increasing train efficiency by re-laying track and strengthening bridges to take heavier (286,000-pound) wagons. However, secondary railway companies often have insufficient return on assets to fund significant new investment or insufficient returns on that investment to justify the necessary expenditure. As a consequence, the heavier wagons cannot be operated (or not operated fully-laden) on those secondary lines.

Gómez-Ibáñez and Meyer (1993) note that sometimes, due to low financial returns, there can be areas of a network that have a lower standard. Thus, these 'socially or politically important' parts of the network are not raised to the standard found elsewhere (pp. 196–97). By way of illustration, since 2003 Britain's Strategic Rail Authority has adopted a strategy of differential standards. It is adopting this approach in order to reduce railway costs. The Authority notes that physical differentiation on the system can be essential to viability and that, in this context, standardisation can be counter-productive:

> One way to reduce costs is through greater differentiation of the network. In some circumstances excessive engineering standards and safety specifications are being imposed with little regard to practical circumstances. … Appropriate engineering standards need not compromise efficiency or safety, whereas over-engineering threatens the economic viability of marginal lines. (Strategic Rail Authority 2003, p. 61)

Similarly, Gómez-Ibáñez and Meyer observe that 'standardization eliminates flexible adaptation of capital to needs'. Further, they note that, for instance in telecommunications,

> …a radio phone might be a more cost-effective way of meeting telecommunications needs in isolated areas than the conventional hard-wired copper line. In essence, the ubiquitous standardized network can create artificial technological or capital constraints that otherwise might be avoided (p. 195).

Thus, there is the risk that intervention to impose a standard will lead to higher costs. This is because imposing harmonisation involves incremental capital costs and may mean higher operating costs than maintaining differentiation.

What is optimal harmonisation?

As discussed in Chapter 1, there are different levels of harmonisation. This term may mean uniform standards, compatible systems or a common protocol. Putting this concept aside, however, harmonisation and diversity each have benefits and costs. Given this, what is 'optimal' harmonisation? We argue that it is a function of factors such as:

- the trade-off between the respective benefits of full standardisation and full customisation and the associated bridging costs;

- the timing of the standard-setting; and
- where existing systems or infrastructure are in place, the returns to investment from increasing harmonisation.

In essence, these factors may mean that the appropriate level of standards may not mean uniform standards. These factors are now considered.

Standardisation versus customisation

At face value we might be inclined to deduce that what industries need are common technical standards. However, all producers face the dilemma of choosing between standardisation (with its many producer and consumer benefits) and customisation (where the output is tailored to particular needs).

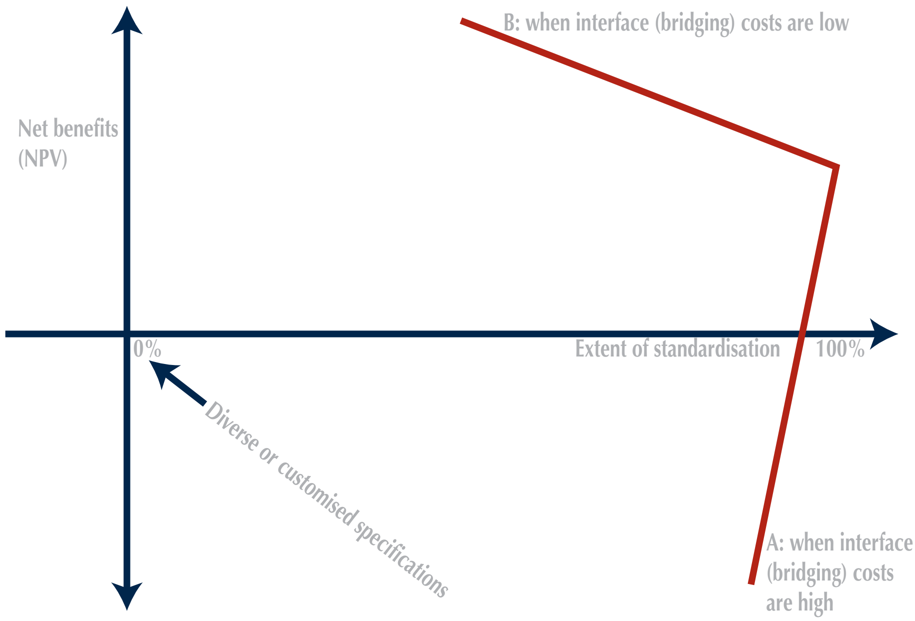
More generally, however, it is not always a stark choice between standardisation and customisation. It is often the case that a broad range of technical standards can co-exist without significant costs to producers or consumers. For example, despite the vast array of television and video player models, most of these products can be connected and work well without problems. Diverse systems can co-exist as long as there is an efficient *standard interface* (compatibility) between the two systems.

There are two important parameters in the balance between standardisation and customisation:

- the interface—or bridging-cost between different systems; and
- the level of traffic across the interface.

Where the bridging cost is low, a customised specification can substitute for the standard—especially where that customisation involves lower capital costs or higher operating efficiencies. Therefore, 'harmonisation' may encompass either strict technical standardised systems or customised systems with a degree of technical compatibility that ensures low bridging costs. This is illustrated in Figure 2.1, where 'A' represents a situation where the bridging costs—whether they be capital costs, operating costs or both—are substantial. Any benefits of customisation, therefore, are outweighed by the high bridging costs (akin to multiple railway gauges). In the

2.1 **Impact of standard-setting with different bridging costs**



case of 'B', the bridging costs are modest and are outweighed by the benefits that flow from customisation. In this latter case it is possible to implement a standard, compatible interface between the different systems at a modest capital cost and/or relatively low efficiency loss arising from installing that interface.

It should be noted that bridging costs may also rise as the number of individual specifications rise. For instance, different railway communications systems can be customised to suit the traffic intensity and the different operating requirements and risks—notably with urban passenger and non-urban freight operations. However, bridging costs rise significantly if *each* railway infrastructure manager has its own form of customisation for each of these operating environments. That is, compatibility is needed between each form of communication and this leads to escalating bridging costs. This cost escalation may only be suppressed where the diverse systems can be bridged with low-cost protocols.

Thus, the appropriate strategy may be to ensure that there is a standardised interface rather than standard products. There can be very strong practical reasons for pursuing compatibility rather than standardisation—that is, to customise the technology for the operational environment. Technical specifications can vary due to factors such as differing uses or geography. For instance, in the Australian railway context, there are proposals to harmonise communications systems. Booz Allen Hamilton (2003) acknowledges the merits of common standards. However, it also notes that it would be impractical to adopt a single radio system that catered for requirements of intense urban train operation and sporadic country train movements.

> There are common requirements between national metropolitan and interstate use of communications, but significant differences in scale and economics. A single technical solution is possible but is likely not to be economic. (BAH 2003, p. 3)

By way of example here, the GSM-R communications technology[32] suits urban railway operations but is impractical in country areas. This is because its radio signals have a very limited reception area around a given radio mast. For GSM-R to be effective in country areas would therefore require a prohibitively large number of repeater radio masts to cover the Australian network. The CDMA technology[33] has a much wider reception area. It has been identified as offering a package of features that would be suitable for country areas despite being unsuitable for urban areas. However, a *practical* interface between the GSM-R and CDMA systems has been developed. Consequently, it is possible to apply each system where it has a comparative operating advantage while still maintaining a practical, network-wide communications system. Thus, in 2005 ARTC announced that it is introducing CDMA in country areas. It is intended that urban infrastructure managers will migrate their communications systems to GSM-R technology.[34]

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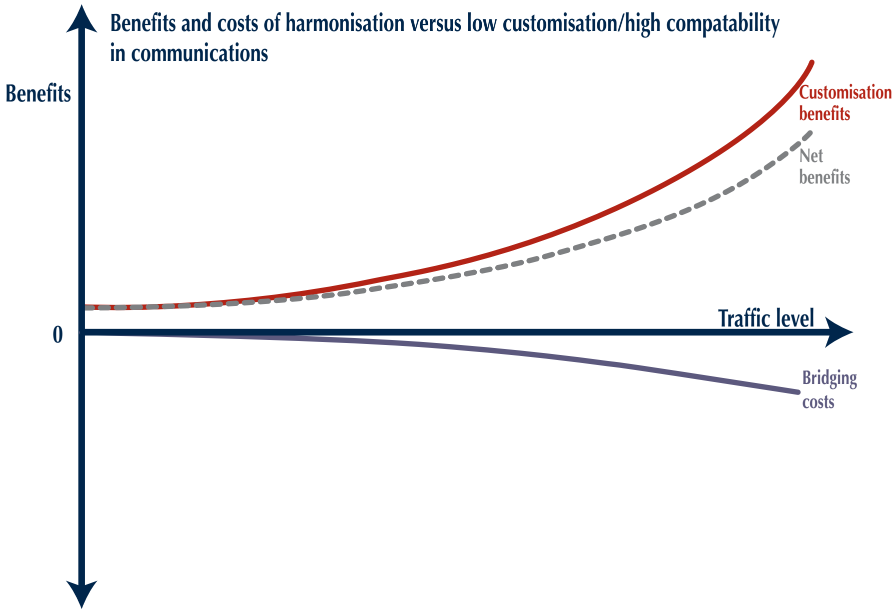
32 GSM-R stands for Global System for Mobile communications-railways.

33 CDMA stands for Code Division Multiple Access. Booz Allen & Hamilton (2003, p. 86) note that this technical compatibility remains ...one of the challenges in mobile telephony'. The proprietor of the CDMA intellectual property is working to establish an interface mechanism '...to effect direct interoperability of dual GSM and CDMA terminal equipment'. The objective is to have a single handset for trains traversing the CDMA and GSM-R networks.

34 See also page 89 for further discussion of this issue.

As noted above, apart from bridging costs, a second key parameter in the balance between standardisation and customisation is the traffic level.[35] In Figure 2.2 we bring these parameters together. The greater the traffic level, the greater the increase in operational benefits of diversity relative to the bridging costs arising from the diversity. Customisation is more likely to be optimal if bridging costs are relatively low—such as where protocols achieve an efficient level

2.2 **Optimal harmonisation in communications (a)**

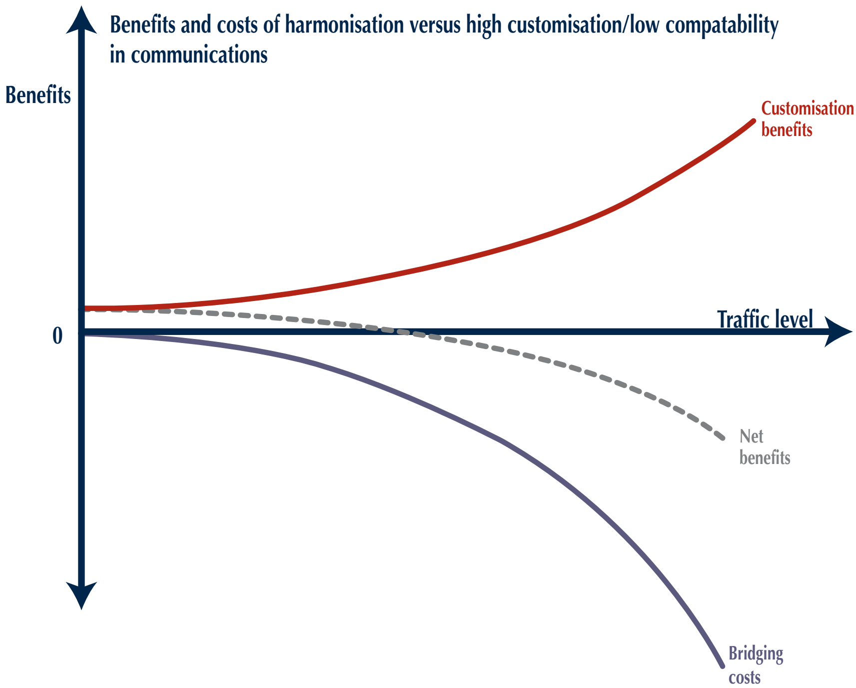


of compatibility—and/or the degree of diversity is low. Figure 2.2 shows that this is the outcome at all traffic levels.

In Figure 2.3, by contrast, the bridging costs are high—due to high costs of achieving compatibility or a high degree of customisation. Thus, the benefits of the customisation are exhausted at relatively low traffic levels. This is particularly important if the bridging volumes of traffic are high.

35 Traffic levels or patterns are not static over time and with the change in traffic the case for an investment changes. For instance, the financial or economic case for enhancing the loading outline on the Brisbane-Melbourne will have improved with the growing use of 10′6″ high containers (in lieu of 9′6″ containers). See ARTC 2005a for a discussion of the merits of the investment benefits.

2.3 Optimal harmonisation in communications (b)



These examples, therefore, illustrate that an efficient solution can involve non-standardisation. This solution relies on having a practical, that is, efficient and low-cost, interface between those two systems. It also illustrates how the volume of business across the interface (the bridging volume) can alter the optimal level of customisation. As Berg notes, the key is:

> ...the availability of a low-cost interface technology that a buyer could use to achieve compatibility. ...[In this way,] the existence of an inexpensive translator or converter partially substitutes for identical standards (Berg 1989, p. 33).

To the extent that such an interface exists in this communications example, the most efficient outcome would, therefore, enable communication provision being tailored to the requirements of the differing operational areas. This would involve using technical compatibility between different radio systems rather than using an inefficient network-wide technical standardisation.

Low-cost, efficient, interfaces do not always exist and the consequences for operational efficiency can be significant. This is especially relevant for railway breaks-of-gauge, where bridging costs usually have relatively high costs—even at low traffic levels. Thus, if business is not to be lost to alternative modes, then goods must be handled in one of three ways:

- trans-shipped across wagons for each gauge;
- wagon wheel sets are re-gauged (using expensive technologies); or
- wheel bogies swapped.

Undertaking these latter bridging activities is costly—in both time and resources. Thus, the operation's cost and inefficiency also increases significantly.[36]

Where interfaces are costly or inefficient, and traffic levels are high, the 'optimal' harmonisation is more likely to involve identical standards. However, as noted above (and is relevant for railways), achieving an optimal outcome also depends upon the standard being defined before construction. If the investment has already occurred, achieving an optimal outcome may mean retaining the inconsistency. This is discussed in detail in the next section.

The railway industry has a diverse range of operating standards which can relate to the need to customise infrastructure. This is particularly

36 The use of bridging devices still imposes costs, particularly in the form of operating costs. By way of example, the rail gauge conversion of the Broken Hill-Port Pirie railway in South Australia (to 1 435mm gauge) in the late 1960s led to break-of-gauge with 1 600mm gauge lines to Adelaide and the hinterland (1 067mm gauge). In lieu of converting those lines, freight between the lines was either transferred by manually shifting goods across wagons or by exchanging the bogies (wheel-sets) under the wagons. The relatively low-cost bogie exchange and the adoption of a manual transfer system avoided significant capital costs but involved higher operating costs that outright gauge conversion. See, for instance, BTE 1976 (p. 29), BTE 1979 (p. 30 and passim) and Nayda et al 1984, (pp. 24-33). Note that the development and widespread use of containers will have reduced significantly these transfer costs as the manual transfer simply involves switching the container across vehicles rather than shifting the individual goods within wagons (as was required previously-and illustrated in Figure 1.6).

the case with urban passenger, bulk/interstate traffic and grain branch-line traffic. However, often the diversity arises across common traffic types. In these circumstances, the diversity is not a result of customisation. Rather, it results from the historical timing process in the adoption of evolving standards and differences in management in the separately-run railway systems. Nonetheless, the balance between standardisation and customisation can reflect differences in:

- available investment funding;
- investment risk decisions;
- level and type of traffic and revenue;
- types of terrain;
- local supplier market; and
- technology available at the time.

Thus, we should recognise that the nature of the assets and the terrain may lead to differing standards. Nonetheless, although those standards vary in different parts of the network, they represent optimal specifications given the limited funding available.

In summary, then, optimal harmonisation can involve customisation rather than a consistent standard across the system. The costs and efficiency of movement across the interface between the standards is the key to whether that diversity becomes an impediment to the operation of the network as a single system.

Case study: freight containers

For land and maritime freight transport, the key dimensions of containers have been defined from the early days of this form of unitisation. The efficiency of containerised movements derives from the interlocking characteristics of the container-whichever mode it is conveyed on. That is, the cost of using multiple modes for conveying goods can be kept relatively low because using containers to convey the goods enables the bridging costs to be kept low.

However, there are various types of containers. For instance, there are refrigerated, open-topped and open-sided containers. Also there is still a wide range of box sizes (especially for domestic-only use). For instance, the NTC reports that perhaps one-half of all new containers in Australia in the last four years have had 'non-standard' dimensions-being defined as more than 40 foot long or greater than 9 feet 6 inches (NTC 2004a, p. 7). Despite this, in general the diverse box types maintain overall compatibility standards. Containers adhere to key interface specifications and the boxes can be handled across a broad range of vehicles, trains, ships and lifting equipment. Important specifications include the holes where equipment can be inserted to lift the boxes. Thus, consistency in handling for international boxes is ensured by maintaining a length of 20 foot or 40 foot and placing the lifting slots in the same position at the extremities of these containers. Domestic boxes have a wide range of lengths and heights and conform to the 8 foot width (though NTC (2004a, p. 7) notes that some containers are made to the 8 foot 2 inch-maximum unrestricted road width-dimension.

The efficiency gains from conformity presented strong impetus for technical adaptations of complementary equipment. Handling equipment, vehicles, wagons and vessels converged to common and compatible standards. For instance, some containers also have compatibility with pallets-two widely-used pallets can fit in to the width of the standard European 2.55 metre-wide container; in turn, this container fits most rail and road routes in Europe. This complementarity in dimensions is akin to the compatibility of a nest of Russian dolls. Most containers have a standard width (2.438 metres) and height (2.591 or 2.896 metres). Containers have lugs in their corners to accept lifting equipment. Without these standards, container-lifting machines would need to be adjusted to accommodate varying dimensions of box; this can significantly reduce the efficiency of moving the boxes. Similarly, the widespread adoption of common standards maximises the flexibility of the boxes and ensures that carrying capacity is maximised on maritime/road/rail vehicles. For example, modern ships are designed to take multiple containers across the hold; if some containers were only slightly wider than standard-width, it could result in one row of containers taking the space of two containers. This would be a high penalty for non-standardisation. Note that countries often have different domestic box standards. This reflects variances in the cargo, especially due to country-specific pallet sizes; or variances in the external environment, such as railway tunnel/bridge dimensions.

Policy environments

Policy diversity can have a similar impact on optimal harmonisation as the geographical, operational, traffic and market needs discussed in the previous section. In particular, even where these needs result in convergence to a common standard, underlying governments' policy environments may dictate that an optimal outcome means differential systems. For Australia's railways, some aspects of the operating environment are a function of governments' transport policies. For example, some Australian systems have been *structurally regulated* as integrated operations while others have been vertically-separated. These structures impact differentially on safety risk. Professor Evans, from the European Transport Safety Council has noted:

> The separation of infrastructure management from rail operation, and the entry of newcomers to the railway scene potentially increase railway risks. Railway fragmentation requires more formal safety processes than in the past.[37] (European Transport Safety Council 1999)

Differential structural regulation affects appropriate operating practices to some extent. This means that if we take the structural form as given, then in some aspects of operation, harmonisation will not be desirable.

This discussion implies that if greater optimisation is sought in operational processes, harmonisation might be required in the policy environment across the network *before* those operational processes can be standardised. That is, if environments differ across jurisdictions, different operating environments are generated. Consequently, it may be undesirable to harmonise, for example, safety regulations.

Timing

The perspective of what optimal harmonisation is depends on the timing of the standard adoption. If the standard is set early, it isolates the loss of non-standardisation to the relatively few producers and users who have committed, or been locked-in, to other specifications.

37 In this context, it has been noted that following the privatisation/vertical separation of British Rail, the staffing of Her Majesty's Railway Inspectorate rose from a pre-privatisation level of 45 staff, including 26 inspectors, to around 200 staff, including 123 inspectors. The Health & Safety Commission/Executive comments that 'This expansion was required in part to operate the new safety regime designed to regulate the privatised industry' (House of Commons Transport Committee 2004, p. 18).

However, while early adoption of a standard provides these benefits, there is also the risk that the standard that is adopted is technically inferior. Withers (2002, p. 10) illustrates how locking-in to a given standard led to the United States adopting inferior NTSC television colour whereas Europe and Australia later adopted the superior PAL system.

The timing of setting a standard therefore carries its own risks. The balance between early and late adoption can be considered thus:

> The associated economic misallocations primarily depend on the extent of the demand penalty associated with product incompatibility and whether premature standardization unnecessarily limits product diversity and reduces innovative activity by firms. (Berg 1989, p. 52)

This observation applies equally to technological development and technological application. Where technological change is underway, there is a danger that prematurely selecting a given system will result in adoption of an inferior system (as in the case of the colour television standard in the United States and the market can become locked-in to that system.[38]

Conversely, if a standard is adopted after the industry has matured, the costs of conforming to that standard can be considerably higher than when the standard is adopted at an early stage. This is particularly relevant for rail, as a large proportion of the industry's assets are long-lived, and may not warrant early replacement. This is discussed in more detail later in this chapter.

Australia's experience with the adoption of multiple railway gauges,[39] and the subsequent high costs involved in subsequently seeking to standardise those gauges, highlight risks in allowing diversity to

38 It should be noted, in the context of railway rail gauges, that in the early years of railway construction the technical advantage of one gauge over another was not clear. As Miller argues, even now there is disagreement as to whether a broader gauge is superior to the current 'standard' gauge (1435mm) (Miller 2003, p. 185). That said, even the strongest advocate of the technical advantage of wide gauges-Isambard Kingdom Brunel-advocated the use of narrower gauge when a given corridor did not merit the additional expenditure involved with constructing the wider gauge-see Rolt 1970, Chapter 'The gauge wars' *passim*.

39 We should acknowledge here, however, that the original development of multiple gauges was due to government decisions, not due to the market.

occur.[40] In 1911, the Commonwealth Government decided to adopt 4′ 8½″ (1435mm) as the standard width of railway gauge. That decision became an important parameter in future railway construction and operating costs.

The issue here is that the market needs to identify when technology has advanced sufficiently to establish that standard. That is, even where the standard-setting and adoption is left to the market (that is, presuming that the market has better knowledge in standards), there is always a risk is that the 'wrong' standard will be adopted or that the benefits of that standard will not be realised. Miller notes that the appropriate standard may be clear only with hindsight and that the wrong choice can be made. This has happened when the European Union imposed the W-CDMA mobile phone standard on 3G phone operators. Further, when different technologies or standards are allowed to compete, that competition encourages each system to be more effective than if a monopoly standard is established at the outset (Miller 2003, p. 10). Given this, as Belak et. al. (1998) note:

> There is a burden of justification of any harmonization: It must be shown to improve the system, that is, the production and distribution system (Belak et al. 1998, p. 24).

The returns to investment

An important factor that works against harmonisation is that it does not generate a return on the required investment. That is, it is not optimal harmonisation. As noted by Greenstein, '…an economic network may never standardize if users lock-in to a disparate variety of formats that each finds is costly to change later' (Greenstein 1992, p. 539). This point reinforces the discussion of timing: that when the standard is adopted will influence what is the optimal level of harmonisation is at any point in time.

The decision by Australia's governments to seek a common rail gauge has influenced what the optimal level of gauge conformity is. The bridging costs across the breaks-of-gauge were generally very substantial—especially when traffic levels were relatively high. So,

40 Generally, the costs in rail gauge conversion are significantly greater when converting to a wider gauge because tunnels and other clearances have to be enlarged whereas when the gauge is narrowed, those clearances are usually smaller.

arguably, the standardisation process of Australia's inter-capital rail lines was one of the more viable and less risky investments. In addition, the investment risk in gauge conversion was relatively low because the conversion costs were relatively identifiable. The existing rail and road traffic flows across the break-of-gauge points provided investors with guidance as to the financial gains that might be captured with standardisation.[41]

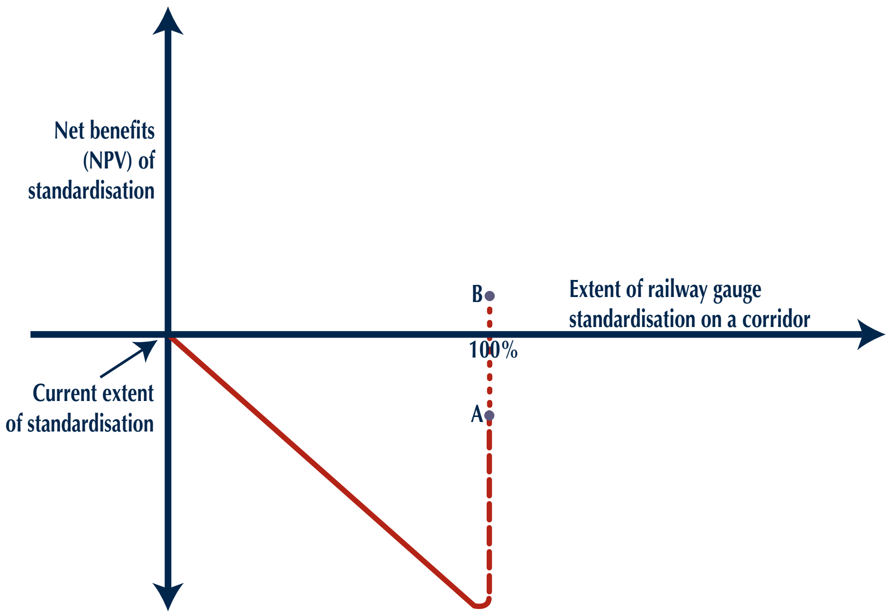
However, often there are no net financial gains for other physical parameters such as harmonising rail weight or loading outline dimensions. In essence, the benefits of these projects are too low and the costs are too high. Considerable funding is required and financial and economic returns are relatively low. Consequently, efforts to harmonise may be justified only when the infrastructure is being renewed. This is especially so if the incremental cost of harmonisation is low—for example, with a higher-specification rail weight. Of course, for the long-lived assets that are commonplace in the railway industry, this means that the harmonisation process can be very protracted.

In Figure 2.4 and Figure 2.5, we present a conceptual view of the net benefits—in Net Present Value terms—of investing in different standardisation schemes. In the first example, the benefits of railway gauge, or loading outline, standardisation on a given corridor are only realised when the total corridor is converted to a single gauge. When the task is completed, the improvements to the railway economics can be realised.[42] As illustrated, we should note that while there is improvement in benefits after the project's completion, it may not mean that *positive* net benefits are accrued. That is, the net result may be point A rather than point B.

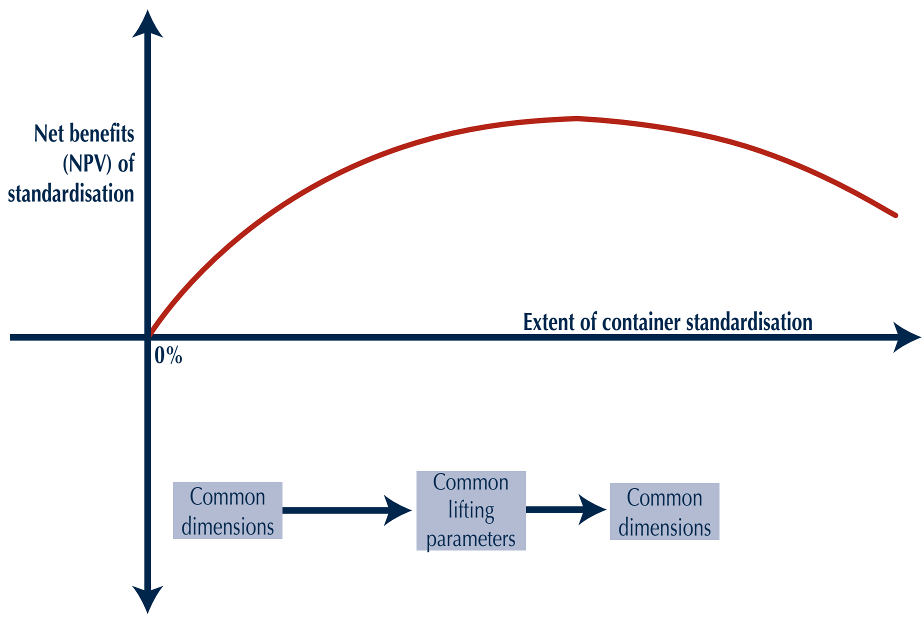
41 In any case, with reasonable traffic levels, gauge conversion costs in isolation can be relatively modest. In practice, such conversion costs are often hidden within the infrastructure upgrade and renewal costs that were often incorporated within standardisation projects. For example, the partial realignment and higher-specified new standard-gauge line between Perth and Kalgoorlie built in the 1960s. However, gauge converting a line from narrow (1 067mm) to standard (1 435mm) gauge is likely to be greater than reducing the gauge width because smaller rail gauge railways tend to have smaller vertical and lateral clearances (loading outlines) and these clearances will need to be increased when the gauge is enlarged. By contrast, when narrowing the rail gauge, the primary task is simply to shift a rail inwards.

42 For railway gauge standardisation, these improvements will include faster services, avoiding trans-shipment of goods, rationalisation of rolling stock (that is, requiring only one set of wagons/locomotives for a given task) and increasing wagon capacity (where greater loading outline allows a greater volume of goods to be carried in a wagon).

2.4 Conceptual impact of investing in gauge standardisation or loading outline enlargement



2.5 Conceptual impact of investing in increasing standardisation on container traffic



In Figure 2.5, we illustrate how the net benefits of container standardisation may change as we move from partial to full customisation of boxes. The illustration shows increasing benefits from standardisation up to a point. These benefits accrue from consistent box dimensions, facilitating box handling and movement across all transport modes.[43] Consistency in container use can also be introduced. This facilitates box utilisation and minimises empty return movements. However, such standardisation would come at the cost of reduced customisation of the boxes themselves: how well do the boxes match the goods that are carried in them?[44] Does over-standardisation make it more difficult to load and unload the contents of the container? Diverse goods require some diversity in boxes. Thus, Figure 2.5 shows that beyond a given point of standardisation, the net benefits decline. This figure illustrates the concept of optimal standardisation or harmonisation. This may, or may not, mean complete harmonisation. Similarly, Figure 2.4 shows that if the net benefits are not present at the point of optimal harmonisation, then the existing position may, by default, be the optimal position.

We should consider this issue now in the context of an Australian freight train industry that has been mostly privatised. Despite the apparent efficiency gains that arise from privatisation, returns on train or, particularly, railway operation are often very low. A related issue is that there are likely to be very limited appropriately-skilled personnel resources that will be available to undertake the arduous task of achieving common standards.

Legacy infrastructure

Some differences in standards between different railway systems have arisen because of the separate management of the railway

43 For instance, the proposal for an EU Directive on 'intermodal loading units' [COM(2003)155] calls for the handling and securing of ILU devices to be made more uniform.

44 For instance, the International Road Transport Union objects to the ILU standardisation proposal as it would require combined transport containers to meet short-sea/waterways shipping needs. This would make such containers heavier, reducing the efficiency of combined transport, even if the containers never went on water. The union concludes that the impact of the directive will be negative, mainly due to the introduced inflexibility in containers meeting market demand and the need for high investment.

systems in each jurisdiction. The legacy of these differences impacts on the optimal level of harmonisation. Combined with the low returns to investment, this means that optimal harmonisation can mean that inconsistent standards, and systems with high bridging costs will persevere until assets are replaced or unless returns improve. This impact of legacy infrastructure is known as 'path dependence'. That is, the historical legacy can bequeath a strategy that may inhibit medium—or even long-term convergence to optimal standardisation. The next two sections consider the impact of legacy infrastructure on optimisation.

Asset longevity

Varying physical standards in the rail industry can result from managers choosing different solutions form those that are available at a given time. In Australia, rail infrastructure was constructed over an extended period of time—from the 1850s until the 1920s. Consequently, the standards of different lines reflect, in part, the standards prevailing at the time of construction. This observation also applies to standards of infrastructure renewal.

The result of this process of evolving standards is arguably more persistent in the railway industry than elsewhere. Rail is characterised by a large proportion of assets with long economic lives relative to other industries. Thus, because replacement rates are slow, if infrastructure is harmonised as it is renewed, the harmonisation process can be very protracted.[45] A consequence of the protracted renewal process is that it is inevitable that the technology will change as the standard is progressively introduced. Thus, the standards will then change.

Premature asset replacement

Given that, in an ideal world, the level of harmonisation would be greater, an alternative approach may be to hasten infrastructure replacement by replacing it before the end of its economic life. If

45 By way of example, the European Commission advocates the European Train Control System for safe-working. The new Betuwe Route for freight operations from Germany to Rotterdam uses the system and, therefore, restricts traction to locomotives that incorporate that system. This incompatibility would remain until the system was more broadly applied, making it worthwhile for operators to retrofit their locomotives. See *Railway Gazette* 2004, p. 614.

the assets have low residual value, this can reinforce the difficulty in establishing an investment case for asset replacement. As NERA has noted,

> ...on the railway it is often difficult to make the case for investment, because of the exceptionally slow rate of asset replacement—with major assets having lives of many decades; and because of the integrated nature of the system. This often leads to extremely long lead times for the benefits of harmonisation. (NERA 2000, p. 128)

Summary

Optimal harmonisation relates to areas where consistency is not financially justified or where a customised outcome is better—where it is more efficient to have differential standards. Those areas where consistency is not justified include the geographical environment, the viability of operation and the cost of bridging technology options.

Geographical environment

Standards may vary from location to location due to the geography in a given area permitting a different standard.

Viability of operation

Low levels of demand and/or high railway construction costs may dictate that some rail lines should be built or maintained to lower standards than other lines. Similarly, high levels of rail traffic—or particular types of traffic—may dictate higher standards. For example, to cater for urban commuter traffic, railways are often equipped with centralised traffic control but simpler, cheaper systems are used on less busy lines.

Cost of bridging technology options

Bridging devices—or adaptors—across differential standards may be adopted at a lower capital cost than full conversion to a uniform standard. Berg, for instance, comments on certain radio and television equipment. He notes that as new technologies were lowering the cost of bridging different technical specifications, agreement on a standard technical specification could be deemed to be unnecessary (Berg 1989, p. 51).

In addition, if infrastructure is already in place, a low return on investment in greater standardisation may mean that the legacy infrastructure becomes, by default, the optimal position until that equipment needs to be replaced.

Will commercial pressures bring about optimal harmonisation?

In this section we consider whether commercial pressures will bring about an optimal level of harmonisation. Then, in the final section of this chapter we consider government's role in achieving optimal harmonisation when it is not achieved through the market.

The Office of Technical Assessments (USA) identifies three main processes for setting the standards:

- ***de facto standard setting*** by default processes of market supply and demand, in the face of coercion from other producers and users;
- ***voluntary consensus,*** through industry organisations and producer groups; and
- ***regulatory standards*** resulting from the political process (Office of Technical Assessment 1992, pp. 101–04) Adopting the regulatory process implies that market pressures alone will not achieve optimisation.

As discussed in Chapter 1, industry players may agree to common specifications (such as common-width railway gauges) or systems that are compatible through use of common interfaces or operating protocols. In this section we consider the factors that work towards and away from optimal harmonisation.

Factors that encourage optimal harmonisation

The business case for harmonisation is that it generates greater efficiency and service quality.

In recent years, there has been a strong shift towards infrastructure management and use of infrastructure across State borders. This shift complements the trends in the overall transport and logistics task across borders. Consequently, the benefits of technical, operational and regulatory harmonisation will also be increasing. For these reasons, there are stronger incentives for rail businesses to review the degree of technical harmonisation. The following sections discuss factors that influence the uptake of common standards.

Network benefits

The presence of network benefits is an important driver to compatibility and harmonisation in railways. The financial gains to all network suppliers and users can generate sufficient market pressures to improve interconnections.

In the second half of the 19th century, North America had a severe railway gauge problem. The market-led resolution to this problem provides an important example of how these financial gains can resolve—what came to be—sub-optimal harmonisation. Puffert (2000, 2001) describes how, by the 1860s, the United States and Canadian railway systems had adopted six major different railway gauges, centred in nine different regional clusters across North America. The United States' railways were generally privately-built and not restricted to individual States.[46] As McDonald notes, for instance, in the United States, the railway industry recognised the disadvantage of State-by-State regulation.

We should contrast the North American experience with that in Australia. Here, the construction and administration of each State's government-built railways largely remained within State borders. This reflected, in part, the tendency in the 1800s for the principal trade flows to occur with Britain rather than across State borders. Consequently, unlike the United States, the downsides of non-standardisation were not recognised or were not discouraged and non-standardisation tended to follow the jurisdictional boundaries.

The diversity of gauges in the United States is perhaps understandable to the extent that, in the early decades of railway construction, there

46 Miller notes, however, that the construction of the United States' railways was often heavily underwritten by public grants, estimated at around 30 percent of the total railway construction cost in the period up to the Civil War. (Miller 2003, p. 42).

were differing views on the merits of different gauges.[47] Indeed, had there been merit in one gauge over another, an early conformity (imposed or otherwise) to a common gauge could have led to the wrong choice being made. Indeed, debate still remains over the merits of gauges wider than the current 'standard' gauge relative to broader gauges (see Miller 2003, p. 185).

In the United States railway market, the industry players resolved to eliminate gauge diversity. They did this after they established that there was no significant operational advantage of one gauge over another, but that there were high bridging costs of diversification. By the time it emerged that there were no clear benefits of one gauge over another,[48] the growth in inter-regional traffic highlighted the higher than expected benefits of inter-regional network integration (Puffert 2000, p. 22). This, then:

> …spurred the development both of interregional systems under common management and of cooperation among railway lines. These systems and cooperating groups facilitated standardization, because they internalized the externalities of the gauge choices of individual local lines. Such mechanisms as side payments, appropriation, and simple coordination thus led to gauge conversions that would have been delayed if each local line had acted simply on the basis of its own incentives. As Liebowitz and Margolis would predict, these mechanisms thus reduced the inefficiency resulting from earlier lack of foresight. (Puffert 2000, p. 16)

By the 1890s, the Scottish (1 435 mm) railway gauge had become the standard and virtually all the railways had been converted to that standard. Thus, despite North America's 19th century gauge muddle, the 'growing demand for interregional traffic and increasing

47 In this context, Greenstein comments that networks (of a common standard) may not develop if most participants are lukewarm about a new standard due to uncertainty about the technology. However, once a 'bandwagon' has started for a given standard, a standard can be quickly adopted, even though that standard may be neither optimal nor of an appropriate standard (p. 539).

48 For instance, a broad gauge is more efficient in allowing higher capacity wagons to be run than wagons on smaller gauges; this comes at the cost of higher construction costs for wider rights-of-way, shallower curves and heavier rails. In practice and if we consider a railway in isolation, the optimal gauge is likely to depending on the anticipated traffic types, traffic levels and terrain.

cooperation among railways yielded incentives' that had largely resolved the gauge disharmony (Puffert 2000, p. 1). Other areas of standardisation—such as inter—system wagon technical specifications—were pursued from the early years of the industry in the United States and, with the railways' own Railway Clearing House, in Great Britain (Miller 2003, p. 187). Other less fundamental areas of non-standardisation that existed across each railway system remained.[49] The consequence of these inconsistencies was not apparent until the systems became consolidated under single management—particularly following the strong merging trend between 1969 and 1996.

The United States' gauge and intersystem wagon experiences demonstrate that financial incentives for consistency can provide powerful commercial drivers towards a common standard. This is especially the case when those standards are crucial to the efficiency of the operation.

Risk

The uptake of a common standard can be strongly influenced by the level of risk associated with adopting the standard. In particular, the establishment and adoption of standards—whether they be operational, technical or regulatory—can involve considerable risk if the efficiencies of that standard rely upon other parties taking up the standard. Thus, Puffert (2000, 2001) has noted that 19th century United States' railway companies saw the benefit in other regional railways having the same rail gauge.

The risk for a firm in adopting a given standard is that the return on the investment will not be realised if the standard uptake is not pervasive. However, industry players in United States' railways acted in concert in the 1880s to minimise this risk. They did this by encouraging the standardisation of key parameters and setting standards for operating rolling stock across other railways' tracks.

49 These differences included different signalling systems but because locomotives and crews generally remained within their own system (except where 'running rights' over another railway's system had been negotiated in fairly infrequent circumstances), there was no significant practical implication of this seemingly unnecessary diversity. Intersystem running in Britain was more prevalent, however, and the member railways of the Railway Clearing House was able to organise a gradual shift towards compatible signalling systems and wagon couplings-see Miller 2003, p. 187.

Gauge

In February 1886, railways agreed to standardise the 15 000 kilometres of trackage that used more than 10 rail gauge widths, to a common 'standard' gauge (1 435mm). This conversion was largely undertaken and completed on two days in the June of that year and this virtually eliminated non-'standard' gauge in that country.

Inter-system operating rules

The early railways adopted a form of self-regulation on inter-system movements: the benefits from common systems were recognised as traffic movements between the railways grew. The major railway systems agreed upon common rules when wagons and locomotives operated over each others systems[50] (Savage 1998, p. 163).

These North American experiences stand in contrast to the Australian railway experiences. Clearly the commercial pressures in the United States were significantly greater than in Australia. Pressure in the United States came from the private ownership of railways there and the relatively early convergence of different gauges and large volumes of inter-system traffic. By contrast, the investment and risk impetus in Australian railways has been relatively muted. In Australia, with ownership and regulation being largely jurisdiction-based, the convergence of different gauges occurred relatively late. The impetus was also muted at that time as there were low levels of inter-system traffic relative to intra-system movements.

Thus, where the financial risks—and the risks that other industry players might adopt other standards—are large, this can actually

50 The United States' *Uniform Code of Railroad Operating Rules* of 1887 included specifications on wagon coupling systems, braking systems, wagon components, motive power design, wagon markings, and telegraph train orders (Savage 1998, p. 23). The railroads initiated other standardisations. Following Britain's lead, in 1883 the United States' railroads established the General Time Convention, which set out time zones across the country. These were an essential aspect of efficient train movements across the country. Savage (1998, p. 145) notes that 'these recommended rules have not been written into federal law' (italics added). An exception is rule 26, dealing with protecting track and equipment workers. Such mandatory rules are known as 'blue signal' rules. (Ibid., p. 159)

encourage players to co-operate and agree upon common standards. For instance, Egyedi (1999, p. 16 and passim) discusses how the risk associated with adopting a diverse-sized container led the various key transport players in the industry in the port of Rotterdam to co-operate. As Egyedi notes, there were high costs involved in constructing container ships or converting conventional ships. There was also a need for specialist equipment, heavy dockside lifting equipment and container storage at harbours.

Government intervention

The threat of government intervention in standard setting may encourage the industry to come together to set, or to adopt, a standard. As Swire notes:

> Industry is often quite explicit that the threat of government regulation is what spurs the adoption of self-regulation (Swire 1997, p. 10).

Factors that work against achieving optimal harmonisation

In this section we consider the factors that can work against achieving optimal harmonisation, despite apparent commercial pressures that would encourage it.

Market failure

Market failure is often advanced as a reason why economic output does not achieve its optimal level. It is a situation where the market fails to provide the socially-optimal level of goods and services.[51] Its occurrence is advanced as a primary rationale for government intervention in specific standard-setting and standard-adoption situations.

Does market failure occur in achieving optimal harmonisation through standard-setting and standard-adoption? That is, can we

51 'Market failure' here is defined narrowly as non-optimal outcomes arising from the public goods characteristics of the goods. Non-optimal outcomes also arise from market imperfections (discussed in the next section) such as where there is less-than-perfect competition in the market.

class standards as public goods?[52] It has been argued that standards are a form of public good, because adopting those standards can have non-excludable and non-rival characteristics. It is difficult to exclude anyone from using a standard even though economic agents can benefit from using the standard without imposing costs on anyone else.[53] The Office of Technical Assessments considers that the absence or underproduction of standards can arise on the basis that standards are public goods. That is, benefits from standards are available to all and no one can be excluded; no one can appropriate the benefits (Office of Technical Assessments 1992, p. 101–02). Similarly, Berg argues that:

> ...a technical standard that is available to all, and whose adoption and use by one firm does not diminish its availability to others, is clearly a Samuelsonian public good. ... To the extent that standards are a public good, the free-rider problem could limit their production. The free-rider problem could justify government intervention. (Berg 1989, p. 31)

Thus, one premise is that, due to non-excludable and non-rival characteristics, standards are public goods. They are then under-provided—that is, they are under-set and under-adopted.

We can acknowledge that these public goods characteristics may then lead to market failure. However, it is unclear to what extent this occurs or the extent to which other factors are more important sources of non-optimal standardisation. For example, the development of toll roads in Melbourne and Sydney has led to

52 Public goods are characterised with two important properties that distinguish them from private goods. First, they involve non-rival consumption, in that consumption of the good does not deprive others of its consumption. Secondly, public goods are non-excludable, in that if such a good is produced, a consumer cannot be denied the benefit of that production (or the cost of exclusion is difficult or costly). Because consumers can benefit from production without being charged, firms may not be able to recover the costs of production, and production will be less than optimal. Similarly, because consumers may derive benefit from production of a good, but without price to signal the optimal level of provision, there is likely to be under-provision of the good relative to the benefit that society gains from that production. For this reason, there is a prima facie case for government to intervene to optimise provision.

53 See, for instance, Berg (1989) for a discussion of technical standards as public goods.

different automatic electronic payment devices. Does the adoption of different devices mean that there is market failure?

Unpriced benefits, low levels of benefits and dispersed benefits can be three sources of this failure.

Unpriced benefits

While toll road users benefit from interoperable collection systems, very few of those benefits extend to the toll road companies.[54] Network providers may ignore network users' benefits in choosing infrastructure standards, particularly if it is not possible to recoup some of the user benefits to meet the cost of harmonisation. Because the benefits of common standards are—in this type of example—unpriced, the market may not produce an efficient level of harmonisation.[55]

Low traffic levels

Market failure may not occur if net benefits are not positive-user benefits from interoperability are exceeded by the costs of building-in the interoperability. For toll mechanisms, it could mean that interoperability equipment costs—including the loss of customised systems for each city—exceed the benefits of interoperability. The benefits are likely to be small if the volume of inconvenienced drivers is low and the level of inconvenience is minimal. This low level of benefits is likely to arise with tolling in Sydney and Melbourne as there are likely to be relatively few drivers who regularly travel on both toll ways due to their considerable distance apart (around 1 000 kilometres) and because the inconvenience of the inconsistency is minimal.

Dispersed benefits

If there are positive net benefits of interoperability, market failure may be averted. This could be achieved if those who stand to gain from the standardised or compatible system can negotiate with the

54 For this reason, the European Commission have proposed the setting of a technology standard for interoperability across tolled roads-see EC 2003.

55 The European Commission is concerned that this might occur with electronic toll collection systems on roads in EU Member States. Consequently, it has proposed harmonisation of systems at an early stage in the expansion of road tolling. See European Commission 2003a.

toll operators. However, in the toll road case, there *are* significant negotiating (or 'transaction') costs that an individual will incur in seeking consistent technology. The cost is significant relative to the benefit that the individual will receive, even though the benefit to society as a whole may be significant. Indeed, there can be a strong incentive for individuals to free-ride on the efforts of others—if all individuals think this way, the situation will not be resolved.[56]

In this context, we can see that there could be a rationale for government intervention to enforce a standard. In this case, however, the two toll ways are regulated by two separate jurisdictions, Victoria and NSW. Even if there was a market failure, this split of regulatory roles could impede the achievement of optimal harmonisation.

Will market failure arise in standard-setting and adoption in Australia's recently-privatised rail industry? Without doubt the industry faces a legacy of non-standardisation associated with State-based public management and traffic flows based on intrastate, rather than inter-system, movements. Private firms will not benefit from early adoption of newly agreed standards. This can be attributed to the legacy of these different standards, the longevity of the assets and the low traffic levels/returns from investment that would harmonise the standards.

But will the new private owners seek to agree common standards and then adopt them? Certainly, the industry does not face the same 'large-number' bargaining and free-rider problem that might otherwise impede optimal harmonisation. The railway industry has only a handful of railway infrastructure managers and train operators. Consequently, the transaction costs are consequently much lower, and the benefits relatively greater, for each entity.[57] The authors accept that there will be incentives for strategic behaviour. Thus, if there are significant benefits from standardisation, it might be expected that commercial industry players will pursue greater harmonisation.

56 See Coase's Theorem in Coase (1960) or Musgrave & Musgrave (1980, pp. 81-82, 753).

57 There are now numerous other service and product suppliers in the market but the infrastructure managers and operators are the key buyers in the market-they are the players who are in the best position to specify and purchase standard or compatible systems.

Market imperfections

(a) Competition

Muted competition in a market is a common form of market imperfection. Market players may adopt incompatibility or non-standardisation because it can be used to dampen competition,[58] ensuring that the price of the product is kept 'high'. Greenstein argues that some firms design systems to be incompatible with other firms. Indeed, they seek to prevent those firms adopting their standards (Greenstein 1992, p. 540). In this way, consumers are locked-in to the prices and products of a given firm.

Any two firms may take different attitudes to harmonisation because of how it affects the relativities of their market power.[59] One firm may want harmonisation because it has a small own-product demand, compared to the other firm's demand. The other firm may prefer incompatibility because its sales are large relative to the sales of the other firm—it has much to lose through competition but little to gain.

The different railway gauges provide a technical barrier for train operators to use their rolling stock to compete in all Australian railway systems. However, though the impediment that it brings to the industry is a historical legacy rather than a conscious strategy for stifling competition. A more general conclusion is that this strategy can be a factor in choosing standards. But when businesses are undertaking '...significant business with one another [they] will try to standardize on similar products, in order to allow greater interaction' (Liebowitz and Margolis 1995). The high degree of interaction and reliance between railway firms suggests that firms will seek to optimise standards rather than to differentiate.

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58 By way of an example from within the network industry, Gómez-Ibáñez (2003, p. 68) notes that the USA telephone company, AT&T, adopted a policy of refusing to interconnect independent telephone companies (which would have benefited all firms' subscribers) because its own network subscribers were greater than others giving it a competitive advantage over other firms that would be diminished if interconnection was made.

59 Gabel (1987, p. 309) discusses the conflicting evidence and notes that IBM was prepared to launch an open-architecture computer (that is, one that is built to a standard that could be taken up by other firms) but subsequently sought to foreclose on this de facto industry standard. This might have been a deliberate strategy or it may have reflected a view that its strategy was financially sub-optimal.

(b) Network benefits of widening network nodes

To the extent that 'externality' benefits arise from widening network use, some researchers argue that market failure occurs when those benefits are not accounted for in optimising harmonisation. In essence, adopting a common standard across an otherwise disparate system—which widens that network—can bestow benefits on all users of that unified network. A specific example is where an individual connects to the telephone network. The usefulness of the network rises as more subscribers are connected. The new subscriber benefits from the connection but that connection brings benefits to other subscribers. Similarly, mobile phones that enable text messages to be sent and received bestow greater benefits on users as the network of subscribers increases.

However, this is not a valid market failure. Network externalities are often discussed in the literature, arising from widening of the network connectivity. Liebowitz and Margolis (1995) observe that these externalities:

> ...are not externalities in the modern sense of causing market failure. Some are not sources of market failure because they are pecuniary externalities, which is a class of externality that does not constitute market failure.

Thus, the so-called network externalities are *pecuniary*, rather than *external* benefits. Public goods characteristics relate to *external* benefits, and/or external costs, and it is these that can bring about market failure. Thus, Liebowitz and Margolis conclude that due to these differences:

> We argue that many of the remaining externalities are not externalities at all, but are better thought of as *network effects* that are resolvable by the familiar mechanisms of ownership and contract that internalize these effects.

These pecuniary externalities represent a form of external effect that is common to all consumer actions. That is, the act of purchasing any goods or services will have an effect, albeit a small effect, on the price. More generally, the perceived uniqueness of these apparent externalities is not unique to networks:

> In some instances, the focus on the network itself merely prevents proper diagnoses of more familiar problems in related markets, conventional problems such as natural monopoly and ordinary production externality ... It is a grand conceptual leap from observing a network effect to concluding the existence of a socially relevant externality. (Liebowitz and Margolis 1995)

Consequently, network externalities, per se, cannot be classed as leading to market failure. In some circumstances, network benefits are significant and the firms do not protect incompatibility as an anti-competitive device. When this is the case, then—in the absence of jurisdictional blockages—firms are likely to seek to internalise those benefits through their own standardisation process or by side-payments to other parties.

(c) Uncertainty

Uncertainty can also lead to sub-optimal standards or level of harmonisation. For instance, there can be diverse forms of technology that are developed and/or adopted.[60] It is inevitable that some forms of technology will end up in developmental cul-de-sacs. This can arise because rival technologies prove to be superior or because of inadequate consumer and/or producer demand.

The authors acknowledge that this is an issue. However, without a degree of certainty about the technological or market superiority of a given standard, it would be difficult for a given producer, or producer group, to advocate that a given specification be a 'standard'. Thus, technical, or market, uncertainty can lead firms to choose diverse technologies or specifications and may discourage them from committing to a common system. This can be one of the challenges of voluntary standardisation groups. Where technical specifications cannot be agreed upon, it may be that different systems are established but firms agree to bridging—or technical compatibility—processes. Examples of this include the interfaces between Microsoft Windows, Apple and Linux computer operating systems.

60 Odlyzko (2004, p. 334) quotes Clifford (writing in 1885) observing that the United Kingdom government left as much choice about the emerging railway technology: 'Parliament wisely refrained from binding the first railway projectors to adopt any specified form of rail.' Inevitably, technological evolution and uncertainty (and differing traffic and geographic conditions) result in a diversity of railway infrastructure-there was no, and there is no, single optimal physical railway.

'Lock-in' to inferior standards

Arthur and Krugman (quoted in Miller 2003) argue that they have identified a form of market failure in standards that arises from technical 'lock-in'. Specifically, they argue that the standard that prevails is the standard adopted by the first firm on the scene. This is due to factors such as sunk capital expenditure and consumer uptake that generate sunk costs. These bring resistance to subsequent change, even if later specifications are superior. The authors illustrate their argument, pointing for instance to the QWERTY typewriter layout and to Windows, rather than Apple, software.

However, Miller refutes the authors' examples. He argues that lock-in to seemingly inferior standards does not occur or that the prevailing standards are not inferior. In any case, Miller puts forward examples where government attempts to second-guess the correct standard have failed and where private firms have then developed protocols that enable different systems to be coordinated. One example given is the work of the World Wide Web Consortium which sets the protocols that coordinate 'the web' systems. (Miller 2003, pp. 26–27)

Asymmetry in the distribution of net benefits and risks in harmonisation

Asymmetry in the distribution of net benefits and risks in harmonisation may impede the achievement of optimal harmonisation. It is notable that this asymmetry exists in Australia's rail system and—when non-market factors are also present—non-optimal harmonisation may occur. In this context, Puffert argues that Australia's State-government-owned railways had trouble negotiating the sharing of the costs of harmonising/standardising their rail gauges. This was due to 'institutional failure' in resolving disputes over the sharing of the costs amongst the States—costs that would otherwise be dealt with by transfer payments or takeovers (Puffert 2001, pp. 10, 29).

The principle of that asymmetry in net benefits and costs for the rail industry can be illustrated with Australia's rail gauges. If it was beneficial to the railway industry to convert Queensland's tracks to standard gauge, virtually all the costs of standardisation would fall to Queensland Rail. QR would then find it easier to get access to, and compete in, southern freight markets. But those would be offset by increased competition from southern train operators in Queensland. Thus, the incentive for a given operator to adopt a standard can be undermined when it faces a disproportionate share of the standardisation costs and uncertain, modest, benefits.

It is not just an imbalance in benefits and costs that can impede standardisation. A related imbalance arises where one party may bear a disproportionate share of the risk of adopting a given standard. In such situations, the party taking a disproportionate share of the risk would need to be compensated for accepting that risk.[61]

The unequal sharing of benefits, costs and risks can, therefore, impede harmonisation.[62] Given this, will market players negotiate a redistribution of the dividends and risks? The market can come to agreement. For example, the construction of the Channel Tunnel high speed railway through Kent in England incurred high costs on the British partner in the passenger train operation. The construction was facilitated by an agreement between the benefiting train operators in the three adjacent countries to redistribute their incremental revenue arising from the opening of the high-speed railway.[63]

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61 This issue is particularly relevant to vertically-separated railways: if investment is undertaken to achieve a given standard, in the first instance the infrastructure manager bears the risk. An agreement between the (former) Railtrack and Virgin Trains to upgrade track in western Britain to a (higher) standard desired by Virgin incorporated revenue-sharing between the two firms. This sharing enhanced Railtrack's incentive to invest and accept additional risk. Arguably, however, this agreement went against the principle of vertical separation and 'may incentivise (sic) Railtrack to favour its business partner over its other customers' (ORR 1997, p. 5).

62 As a related issue, Phillips (1987) notes that where firms seek to agree upon a standard, the gains and losses across the firms also includes divergent institutional and individual objectives. Thus, concludes Phillips, 'While the parties share some goals, their individual objectives are highly diverse and often conflicting. ... The menus of feasible technical and behavioural standards are not neutral with respect to total payoff or to the distribution of that payoff. It is no wonder that standard setting is so time- and resource-consuming in this kind of network situation'. (1987, p. 278)

63 The approach to encouraging the British operator to build additional, and faster, track capacity consists of two components. First, the operator is awarded a (temporarily) higher share of the additional revenue that is assessed as arising from the new investment. Secondly, to encourage the investment to occur earlier rather than later, the period for the British company earning the higher revenue share is fixed in time; as a consequence, the later the completion of the infrastructure, the less is the additional revenue share that will accrue to the British firm.

But reaching agreement almost inevitably involves strategic positioning by the negotiating players and this can impede achieving consensus. For instance, Blonk and Wykle observe that the introduction of new standards in container and pallet systems:

> ...reallocates benefits and costs, and such a transition raises the difficult issues associated with how the costs and benefits will fall on companies at different points along the supply chain (Blonk and Wykle 1998, p. 2).

Reaching consensus in such a situation is difficult because

> ...while the overall benefits are evident, and the range of options is narrow, many parties have a competitive interest in one solution or another, and an agreement on standards cannot be reached until a vast majority of affected interests see a common gain in standardization. (Ibid.)

Another factor that can make it difficult for the market to come to a solution is that players need to estimate the scheme's benefits for each player. If the benefits cannot be established readily, and consensus achieved, it can be difficult to agree upon the revenue share. NERA (2000) has noted, in the context of European Member States harmonisation:

> One factor is that the benefits and costs are skewed between Member States. For example, harmonisation will often take the form of one railway adopting the arrangements of another, where the costs all fall on the first and the benefits are shared. It may be difficult to negotiate a mutually acceptable sharing of the benefits, which are long term and hard to quantify with any precision. (NERA 2000, p. 88)

Thus, generally, it is more difficult to resolve a harmonisation issue when the benefits, costs and risks of harmonising are distributed unequally. If the benefits, costs and risks are spread evenly across users, or are internal to the firm, problems are resolved more easily. In principle, where the benefits of harmonisation exceed the cost, the 'winners' of any harmonised activity should be able to compensate the 'losers'. This requires consensus, though, on what those benefits are likely to be, to calculate the respective distribution. Further, it does not preclude tactical behaviour by players or 'large' numbers of players that may make it difficult to achieve consensus.

Asymmetry in net benefits and risks in standard adoption may not be resolved by the market.

The number of industry players

We noted above that asymmetry in the benefits and costs can impede optimised harmonisation. However, this may be overcome to the extent that the major beneficiaries of standardisation can reward those parties who incur a disproportionate share of the costs. So, if there is a significant number of industry participants, that is likely to impede the standard-setting and standard-adoption process.

An important example here relates to the vertical separation—with mandated access—of the railways. This increases the number of industry players who are affected by establishing a given technical standard and can make it more difficult for interested parties to achieve consensus on given standards. Optimising standards for the wheel-rail interface is an important, specific, manifestation of this issue.[64] With Australia's traditional-sole-user, vertically-integrated-railway, the interface could be managed as a single system. However, this changed with vertical separation and mandated access to the infrastructure:

> One of the primary problems which research has identified is that, as the wheel/rail interface can only be managed as a system, changes to one side of the interface will frequently deliver benefits to the other... If the industry is ever going to optimise the wheel/rail system as a whole, this issue of costs and benefits accruing to different organisations within a fragmented structure demands compensating adjustments in the financial sphere. (Doherty 2004, p. 403)

As Greenstein notes:

> The existence of many buyers and sellers partially produces the coordination problems because diffuse decisionmaking tends to lead

64 The wheel-rail interface is a term that describes the physical interrelationship between above-rail activities and below-rail activities. Each area has a physical impact on the other area, e.g., an irregular-shaped wheel impacts on the wheel itself as well as on the rail. The uncertainty and management issues arising from this and other operational interfaces in railways result in high transaction costs between the activities. This leads firms to organise these activities within the firm and recent structural regulation, which has separated these activities, should be considered in this context.

> to unsponsored standards. ... [However] Each decision maker has too little incentive to make the investments that will coordinate the activities of other users (Greenstein 1992, p. 539).

Firms and users may benefit from setting standards. However, if there are many firms and users, it is more likely that no individual beneficiary will have sufficient incentive to account for other users' benefits that arise from setting a standard. A consequence can be that there is insufficient investment in standard setting.[65]

Australia's railway industry has relatively few players—defined as train, infrastructure and railway operators—so consensus should be easier than where there are many players.

Institutional setting

The institutional setting in which an industry operates can have important parameters that influence the extent to which the industry optimises harmonisation. The primary factors here are government regulatory oversight and government ownership.

Important factors that may have impeded optimal harmonisation within Australia's railway industry are:

- public ownership of most railways, with relatively weak profit-making incentives; and
- oversight of these operations by multiple sovereign jurisdictions, that is, Australia's national, State and Territory governments.

Much greater standardisation would have been achieved—notably in railway gauges—if there had been a single, sovereign, government in Australia when the railways were built. By contrast, following the 1845 Gauge Commission, Great Britain's Gauge Act of 1846 specified a single standard railway gauge for that island. The choice of gauge was facilitated by technical trials of the merits of different (4′ 8½″, 7′ 0¼″) gauges. However, Miller notes that the technical superiority of one gauge over another remains disputed to this day (Miller 2003, p. 185). Nonetheless, the national government's declaration that a single, 'standard' gauge, prevented the further proliferation of breaks-

65 Even assuming that small firms can combine to introduce a standard, if that is undertaken when the market is dominated by one firm, Gabel argues that the task would be 'extremely difficult' (Gabel 1987, p. 310).

of-gauge. The breaks finally disappeared with the conversion of the remaining broad gauge in 1892.

Government regulatory environment

Regulations are a substantial factor influencing the extent to which railways can harmonise their operations. We have already noted that the way a railway is structurally regulated will influence operations and safety systems. This will influence optimal harmonisation.

Thus, in these regulations we find that a substantial degree of the process of optimising the railway operating environment lies outside of the control of railway industry participants. The regulations determine or influence the:

- nature of the firms—for example, through vertical separation;
- the cost of operations—such as through access charges; and
- the way that the firm operates—notably, through operating processes and safety systems.

These regulations may differ from jurisdiction to jurisdiction. The differences are not because of differing finances, operating environment—for example, legacy equipment, terrain or traffic levels/types—or safety risk. Rather, the regulations are different because the decisions are being made by separate sovereign entities. Such entities do not have the direct commercial pressures to ensure that those regulations converge to common specifications. Thus, these regulations potentially inhibit optimisation of physical standards so that they meet different regulatory standards. But they are also an important class of the industry environment where the parameters are not optimised.

Service provision by non-market institutions

In an article published in *The Journal of Economic History*, Puffert analysed the North American railway gauge standardisation of the late nineteenth century. He also questioned why, if market forces could bring about standardisation in North America, it had not been achieved in other locations. He suggested two factors that inhibit this convergence in Australia:

- interregional traffic may be low and not sufficient to justify the costs of conversion; and

- there may be institutional factors that prevent internalisation of externalities—for example, as happens when the railways are owned by different States (Puffert 2000, p. 22).

The imbalance between traffic and costs accounts for the low returns on investment, discussed above. This can certainly be a factor in Australia for the persistence of non-standards, which Puffert (2000, p. 31) is explicitly referring to (2000, p. 31).

Until recently, Australia's common-carrier railways were publicly-owned and that ownership was governed by State jurisdictions. There were varying degrees of political directives on non-commercial rate-setting and loss-making service provision. In that environment, the commercial pressures on the railways were muted.[66] The political environment is also federal, with each jurisdiction having sovereign rights over the way it operates its railway systems. Thus, non-optimal outcomes can result, and can then prevail, as each jurisdiction protects its rights in the environment of muted commercial incentives. The institutional setting can inhibit the commercial optimisation of standardisation.

Thus, if current standards are non-optimal, it is due, in part, to the jurisdictional framework, rather than to initial errors in setting a common gauge in the colonies. Thus, we can note that gauge, and wagon, diversity also occurred in North America and Great Britain. But their private owners—with minimal government involvement—resolved these differences. The absence of the commercial impetus has probably meant that external net benefits of standardisation cannot be internalised. As Puffert notes, '...government-owned railway systems may have difficulty internalizing their mutual externalities through side payments or (international or interstate) takeovers'. Consequently, the '...lack of internalization mechanism may hinder conversion that would be worth the cost' (Puffert 2001, p. 29).[67]

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66 Industry Commission (1991, p. 41) notes that political interference in railway decision-making impacted on railways' financial performance. The accumulated impact of the interference and strengthening road competition led to escalating financial losses and 'Parliaments tended to blame railway management for the reversal of fortune, not recognising that government policy also was to blame'. One aspect of reforms during the 1980s was to seek to circumscribe the political involvement.

67 Puffert notes that an additional 'internalisation' mechanism is the customers' own demand for traffic across the standard divide. Thus, '...in North America, cooperation and system-building led to a rapid conversion [of track to a common railway gauge] as demand grew for interregional transport. Indeed, given that this happened relatively early in the development of both traffic demand and interregional systems, one may conclude that even a much greater diversity of gauge, had it happened to develop, would eventually have been resolved.'

In principle, reforms in the last decade have increased the likelihood that industry players themselves will strive to optimise technical standardisation. Government has, Queensland apart, now withdrawn from operation of freight train operations. The rail freight industry has consolidated to two main players—Pacific National and Queensland Rail. We noted earlier that a consensus on standard-setting and adoption is more likely when there are relatively few industry players. Thus, Australia's railways are now operated by a consolidated group, with most of the interstate track being managed by one company, ARTC. This small group of significant train and track players should provide a more conducive environment for optimising rail standards without government intervention.

The authors note, however, that while the privatisations have moved the industry away from muted, commercial, jurisdiction-based operations, the influence of the multi-jurisdictional framework continues. Indeed, the introduction of government structural, access and safety regulations in the last decade has amplified the impact of the multi-jurisdictional regulatory environment. In technical standard-setting the force of commercial pressure is likely to move the industry towards optimising harmonisation. However, in the multi-jurisdictional regulatory framework there is no equivalent force to commercial pressure to ensure that regulations will converge to optimal consistency.

Conclusion

In the foregoing discussion we have considered several different reasons why, with market forces alone, there will be some degree of sub-optimal standardisation. We have set out different possible sources for this sub-optimality. We note, however, that the outcome may well arise for more than one of these reasons. For instance, sub-optimal standardisation can arise because:

- firms may seek non-standardisation to reduce competition;
- there are many industry players, which makes it difficult to achieve consensus on standards;
- there is asymmetry in the distribution of benefits and costs; and
- there is uncertainty in establishing the best standard.

That said, in network industries and—particularly in the mostly, recently-privatised Australian railway industry—the incentives for unimpeded flows across the network will be stronger than erecting competition barriers along the network. Also, there are relatively few industry players—notably, infrastructure managers, train operators and railway operators. This will make consensus on standards easier than if there were many players.

It is apparent that multiple standards such as Australia's three primary railway gauges are inefficient. Their persistence is probably attributable to:

- lack of an investment case to justify adoption of a common standard;
- the muted commercial, or non-commercial, government-owned operations; and
- the jurisdictional rigidities embodied in sovereign governments.

As discussed earlier, path dependence from the historical legacy of infrastructure can bequeath a strategy that may inhibit medium—or even long-term convergence to what would otherwise be regarded as optimal standardisation. Of course, achieving that convergence is even more protracted when commercial pressures are muted.

Government role in optimising harmonisation

It is possible to argue that there is a role for government in setting a standard and for mandating compliance where there is market failure and, by implication, public welfare issues. To the extent that there is evidence of sub-optimal harmonisation in standard-setting or standard-adoption, we turn now to consider the government's role in optimisation.

Forms of intervention

Government intervention may take one of three principal forms—ranging from guidance through to legislated requirements and specification:

- a coordination and facilitation role;

- financial support; and/or
- regulation and enforcement.

The choice of intervention in standard-setting and adoption is likely to be crucial in whether the intervention brings about net benefits.

When there is a case for government intervention it is nonetheless important to consider the consequences of applying these different forms of intervention. In particular, in the context of adopting standards, the Commonwealth Interdepartmental Committee on Quasi-regulation noted that:

> Government regulators have made use of Australian Standards without adequate assessment of whether they are necessary to meet the objectives of the regulation. One consequence is that quite technical, prescriptive and input oriented Australian Standards are referred to in regulation when a more outcome oriented approach may have resulted in more effective regulation. (CICQ 1997 p. xvi)

Since 1999, the Australian Government has adopted a facilitation role to bring about greater uniformity through the development of the industry's Code of Practice. This essentially leaves the detail of harmonisation to industry players. The government stated that if this approach did not bring about the changes that it perceived were needed, it would intervene more directly:

> - In support of national rail uniformity and its associated cost savings and improved service, the Commonwealth to examine, before 2001–02, the need and options for providing further Commonwealth assistance with the transition to the national specification of operational protocols. Any assistance would be subject to the rail industry demonstrating significant progress towards achieving harmonised operations.
>
> - Should industry co-regulation and implementation of the national rail operational codes not be working effectively by mid-2001, the Commonwealth to seek agreement of jurisdictions to establish a new institutional framework for the rail industry, similar to the National Road Transport Commission [NRTC], using Commonwealth legislation. (Anderson 2000, p. 6)

Since then, the Government has broadened the base of the National Road Transport Commission to include rail. This led to the establishment of the National Transport Commission, to pursue national approaches to the rail industry.

What are the merits of government intervention in standard-setting and adoption? Can government generate a better outcome? In the next section we consider the extent to which government failure might arise in this intervention.

Government failure

As discussed above, industry players face the risk that the technical standard they adopt will quickly become superseded or that other industry players will not adopt the same specification. There are also risks in setting the wrong standards and excessive standardisation: '…standardisation and harmonisation, when taken too far, can be counterproductive' (Milz and Bayliss 2005, p. 10). In this context:

> …standardisation and harmonisation should never be objectives in themselves and should not unduly prevent necessary customisation to accommodate special local conditions. Nor should they be allowed to stifle worthwhile innovation (Mitz and Bayless 2005, p. 10).

Given this, can governments improve on the standard setting and adoption processes? In the following sections, we briefly consider the main issues.

Comparative advantage

There is no doubt that government has authority in setting and enforcing standards. However, it has no inherent advantages in identifying the appropriate standards, or in establishing the optimal level of harmonisation. Government agencies also have no capacity to reduce the technological or market uncertainty. In this context, the industry is likely to bear most, or all, of the risk associated with standards.

Indeed, government intervention can have undesirable effects. For example, the International Union of combined Road-Rail transport companies[68] has expressed concern about the European Commission's

68 Union Internationale des sociétés de transport combiné Rail-Route, UIRR

intention to create a compulsory, stackable, standard 'euro-container'. The association believes there is a risk that such a container will preclude the use of specialised containers that are used for movements on 'swap-bodies' and semi-trailers. That is, the association fears that the European Commission is not acknowledging the merits of customisation. The Union pleads for 'free competition' to be the mechanism for deciding the type(s) of container to be used on different modes of transport (International Transport Journal 2004, p. 34)

For harmonisation, then, there are two primary concerns with government intervention in standard-setting and enforcement:

Setting standards

As Berg has noted, 'regulation could mandate a particular standard, but this process can involve lags, high information costs, and mistakes' (Berg, p. 38). That is, even if it is appropriate to have a standard for a wide range of situations and/or products, it is also critical that the most efficient standards are chosen.

Enforcing standards

The success of setting standards may involve coercion or mandating of industry players in adapting those standards. As NERA (2000) warns, however, there are dangers in overriding business decisions and using European law to impose standards. It notes that

the implicit assumption is that the committees of standards institutions know better how to run the companies in the supply and operating industry than those who are selected and paid to do the job. Such standards carry the risk of generating bureaucracy and cost without corresponding benefits (NERA 2000, p. 128).

Consequently, government may be poorly placed to identify the appropriate standard specification and the appropriate level of standardisation relative to industry players.

Compliance costs

The Productivity Commission has noted that 'even where there is a prima facie case for regulation, interventions themselves can be costly, due to their effects on incentives and their administrative, legal and other burdens' (Banks 2002, p. 2).

Regulatory inertia

Savage notes that there is danger in government-dictated standards, which he argues can fossilise outdated technology and working practices. Further, he argues that:

> …there is clear evidence that once written into law, specification standards become so inflexible and so politicized that changes in technology and engineering knowledge are held back. (Savage 1998, p. 163)

Regulatory structure

The institutional framework of government intervention can also work against the success of that intervention. This is particularly the case when the intervention is in the form of regulations.

In Australian railways, government intervention has an additional dimension in the matrix of outcomes because regulations are imposed by each State and Territory jurisdiction. Optimal harmonisation needs to reflect variations in financial and safety risks and differing operating environments—which can be a significant matrix of considerations. Thus, this task in itself is a challenge for government to outperform the private sector. However, to the extent there are multiple governments overseeing and interpreting the task, more diversity is likely. This is likely to mean greater sub-optimality in outcomes.

Competition

Competition in the market can also be affected when government adopts a strong interventionist approach. David and Greenstein note that the standard-setting regulatory process can favour some firms:

> …some groups systematically acquire more influence than others because they are unequally represented when the issues are arcane. Even though government would like to require that all relevant parties be represented, not all parties can be identified (David & Greenstein 1990, p. 31).

They also argue that the regulatory process '...will also tend to protect old standards and accentuate identifiable 'vested' interests. (Ibid., p. 31).

Box 1 Railway issues with standard-setting-case overview

The railway industry could be described as having 'mature' technology, with 200 years of history. Nonetheless, while the industry's basic technological principle-metal wheels on metal rails-remains, the engineering of the industry has evolved with technological change. Indeed, the industry is facing very rapid railway-specific and non-railway-specific technological change. Permanent-way [track] standards, rolling stock, goods-tracking technology and signalling and communications equipment are some of the broad areas of technological change. For instance, new processes in steel rail production and wagon wheel designs enables considerably heavier wagons to be operated.

Given this background of change, the issue of optimal standard-setting is as pertinent today as when the network was established. One of the current issues in Australian rail infrastructure is rail communications standards. The rail network has a legacy of multiple communications systems-should these be standardised? The presumption might be that a single standard would eliminate the need for train operators to be equipped with and operate multiple systems. This would reduce capital and training costs and streamline communication processes. However, in choosing a given standard, the technology must be suitable for the terrain, the traffic levels and to the signalling system used.

Adopting a single standard may mean, for example, that the communications system could be costly and over-engineered if traffic is low; and the system could be inadequate where traffic levels are very high. By contrast, multiple standards offer cost-effective solutions, tailored to specific traffic levels.

In practice, communication standards optimality may require the adoption of multiple systems-as long as there is efficient bridging technology that brings about technical compatibility between the dissimilar systems. This outcome is likely to arise in Australia, as ARTC has chosen CDMA technology for its interstate and Hunter Valley operations. However, future urban railway communications are likely to choose GSM-R radio technology-see Booz Allen & Hamilton 2003, p. 52; ARTC 2005b).

Communications technology has developed rapidly in recent years. In this context-and remembering that government does not have a comparative advantage in identifying the most appropriate type or degree of standardisation-this implies that standards should not be mandated. However, this does not rule out a government role in facilitating dialogue between industry players or a role in ensuring that, where players do adopt different systems, there is efficient compatibility between those systems.

What role for government?

In the context of this report, there are two specific roles for government. The first government role lies in the external environment that it imposes on the railway industry—the form of industry structure, mandated access and safety regulations. Because of the federal nature of Australia's government system, there is an institutional risk that, far from optimising the external environment, the government could create a less optimal environment. The multiple decision-making could lead to multiple outcomes for similar operating, terrain and risk situations. Arguably, for similar situations in Australia, similar regulatory environments should be imposed on industry players. In this context the optimal harmonisation is a common standard for similar environments. We discuss this further in Chapter 4, where we consider issues of regulatory harmonisation.

The second government role lies in its passive or active role in the setting and applying technical standards. The foregoing suggests that, depending on the nature of government's role, there can be significant risks arising from its intervention in standard-setting and adoption. Despite these risks, Gómez-Ibáñez and Meyer (1993) have noted that '...strong political support for the ubiquitous standardized network arises even when the economics run strongly to the contrary' (p. 195).

Even though there may be evidence of market failure, or market imperfections, there is the risk that

> ...government intervention is inappropriate because network externalities cannot be identified in practice or government action is likely to be more costly than any benefits it may produce (Page and Lopatka, undated).

When railways were publicly-owned, railway managers opposed intervention in the form of a national body regulating standards. They preferred to converge on standards through cooperation. One railway operator also noted that such regulation could hinder, rather than facilitate, technical innovation (Industry Commission 1991, p. 343).

Gabel's review of a range of papers on product standardisation concluded:

> Although free markets will fail to guarantee an efficient amount of standardization (a conclusion of virtually every paper written on the topic), none of the papers presented at the symposium advocated active public policy regulatory intervention to remedy that failure. This is consistent with other recently published work, which generally avoids proposals for public policy activism despite universal awareness of the limitations of free markets (Gabel 1987, p. 305).

David and Greenstein (1990) suggest guidelines for the role of government. They note that some literature indicates that the appropriate form of intervention—ratifying market standards, influencing the standards—setting process or mandating standards—will be shaped by '...the character of interactions between government regulators and industry participants' (David & Greenstein 1990, p. 30). For example:

- where relevant technical deliberations on standards have already taken place, government should rely on industry evaluations rather than conducting its own evaluations;
- government should not mandate standards if the standards are likely to be revised (such as when technology is evolving rapidly);

- performance specifications are to be preferred to design specifications; and
- where industry response to proposals is lukewarm, or where industry players attempt to break from mandatory standards, this may suggest that premature standard-setting has occurred—such evidence should not be ignored (David and Greenstein 1990, passim, p. 30).

Sub-optimal harmonisation can occur because of market imperfections or because the government sets inappropriate standards. To the extent that industry bears the cost of this, then the first presumption should be that low-risk government intervention is preferable to, for example, regulatory intervention. Thus, the government role of coordination and facilitation is preferable to government intervention in regulated standard-setting and adoption.

Chapter 3

Technical harmonisation

Summary

We consider the consequences of diverse technical specifications. The apparent costs of having this diversity need to be set against the benefits flowing from diversity at the local level, that is, from customisation. The impact of an inconsistency is greatest where there are high traffic flows and where the costs of bridging that inconsistency are large. This is particularly the case with breaks-of-railway gauge, with high trans-shipment costs, unnecessary duplication of rolling stock and time delays. However, the levels of freight flowing across those remaining breaks in Australia are very modest, so the direct transport costs of those inconsistencies are low and the financial case for standardisation is likely to be weak.

There are other areas of infrastructure diversity. For instance, train capacity standards (loading outline, axle loads and trailing load) vary considerably across the network. These differences reflect, in part, the varying terrain, the standards needed to meet the traffic flows and the legacy of independent State-based management. There is a case for some diversity in provision of track, train and terminal capacities, reflecting varying demand for capacity over different parts of the network and differing costs of provision. Any case for investing in greater standardisation will depend on individual cost-benefit assessments.

The case for diversity in safeworking and communications is less clear-cut. There are different forms of communicating instructions to drivers, different authorities to proceed and different ways for signallers to establish train location. Similarly, communications systems are inconsistent *and* lack interoperability. The network also has different safeworking and communications systems which are often incompatible, leading to high bridging costs: there is a need for additional training and equipment and it is harder to achieve given safety standards. The development of a common management of most of the interstate network should ensure that, as the business case for replacement of the systems comes about, the new systems should be to a common standard or compatible (through protocol standards). However, with long-lived assets, it is commercial reality that this process is likely to be protracted.

In this chapter, we consider the issues of optimal harmonisation of technical railway parameters. Discussing optimal harmonisation, we consider, briefly, aspects of optimal technical harmonisation—how and where customised and standardised specifications should be applied. We then consider the industry's efforts to establish an umbrella of technical standards or compatibility, and common operating practices, through development of its own Code of Practice. These standards are also related to safety issues—which are considered further in Chapter 4. We then review the range of technical standards—such as axle load limits and loading outlines—and consider how sub-optimal standard adoption affects railway economics.

Optimal technical harmonisation

In the previous chapter we considered the issue of optimal harmonisation and whether commercial pressures will bring about 'optimality'.[69] However, as we noted, the case for standardisation can be weak if unit bridging costs across different standards are high but the actual or potential number of units flowing across the bridge is low. In some cases, the typically long-lived equipment or infrastructure eventually needs to be renewed. This is an opportunity to alter the technical specification. In the meantime, there may be no case for standardising.

Apart from railway gauge, the other technical parameters can be categorised into four main areas:

- capacity—train, track and terminal);
- track management—safeworking systems
- communications—such as radio; and
- propulsion power sources.

In each case, there are bridging costs—such as in multiple communications systems or inefficient train operation arising from inconsistent provision of capacity.

69 Note that we are presuming that the degree of standardisation has not been excessive when a common standard *has* been established.

Optimal technical harmonisation is an inter-relationship between complementary technologies and specifications. For practical purposes, each technical standard is normally considered individually. But, in practice, standards can be interrelated.[70] For example, installing heavy rail to enable heavy axle loads will be costly and inefficient if there is not also a complementary standard of bridges or track bed to that will support those heavier loads. In any case, for this task Booz Allen Hamilton notes:

> ...producing a fully optimised network layout normally requires extensive analysis of traffic requirements and detailed computer simulation of the network operation (Booz Allen Hamilton 2001a, p. 6).

As noted in the previous chapter, optimal harmonisation is a balance between standardisation and customisation. However, it often includes forms of bridging that enable the different standards to co-exist. A key issue with standard adoption is the cost of different standards: technological application must be 'fit-for-purpose' and account for the resources that used to construct and operate the railway. Several different situations, discussed below, support the case for customisation, including:

Traffic intensity

More intensely used track requires additional capacity. This may be achieved through higher standards of signalling, communications, specifications of rolling stock and locomotives, loading outlines, track beds and terminals.

Traffic types

External electrical power supplies are desirable for intensive, frequent-stopping urban passenger operations. However, diesel-powered propulsion is usually more cost—and operationally-effective

70 Inevitably, our discussion cannot be exhaustive though we have sought to identify the primary technical differences. In their study for the European Commission, NERA additionally identifies the following areas of diversity in Europe: platform height, weight of traction and track curvature, crash resistance, wheel size, locomotive cab design, fire safety, emergency escape routes in passenger carriages, door locks, front window shield impact protection and use of asbestos. (NERA 2000, pp. 83-87).

elsewhere. Bulk haulage freight requires fit-for-purpose loading and unloading facilities that differ from intermodal terminal facilities.

Risk

The likelihood of an event occurring varies across the network. For instance, there can be varying safety risk levels, and consequences at different road-rail crossings, arising from factors such as visibility and traffic volume. Consequently, some crossings are grade-separated, others are protected by moving barriers and others by 'stop' signs. Another important variation arises due to the type of train operated. Types of risk, and the level of risk to humans, are generally much greater with passenger trains in urban areas than freight trains in rural areas.

Geography

In general, construction and operation of railways on flat, open terrain permits higher standards than in mountainous terrain. Desirable standards on track straightness and gradient are relaxed in mountainous terrain. Similarly, compromises on standards are needed when building bridges, embankments, cuttings and tunnels.

The authors also note that, in addition to these factors, governments and the private sector must acknowledge other prevailing factors when a railway is built or renewed. These include the financial budget, traffic and revenue projections and risk aversion. These influence the short-term environment on decision-making for the technical standard.

Thus, while standardised specifications are implicitly preferred, technical standards are customised to be fit-for-purpose or tailored to fit a budget. Nonetheless, the greater the degree of bridging movements, and bridging costs, the less desirable it will be to have a plethora of standards.

Industry Code of Practice

In recent years the industry, through the industry association, the Australasian Railway Association (ARA), and facilitated by government, has developed common standards and practices. The Code of Practice sets technical and operational guidelines for railway firms. We note that there is a relationship between technical and operational systems, and safety systems.[71] However, in the first instance we consider the code to be technical matters. As the Australian Rail Safety Accreditation Authorities (ARSAA)[72] have observed:

> ...discussion on operating procedures and standards, radio communications, axle loads and speed restrictions, safeworking systems and codes of practice are considered under the heading of rail safety and safety co-regulation. These issues obviously contain safety elements so it is easy to see how the uninitiated can consider these things to be safety issues in the control of Accreditation Authorities [i.e., safety regulators] and to call on the Accreditation Authorities to fix them up. [Nonetheless it]... is appropriate to treat safety co-regulation and operating procedures and standards as separate matters.' (ARSAA 2001, p. 26)

The Code has its origins in development work by Railways of Australia (precursor to the ARA). In the early 1990s, it was developing a range of technical, operational and maintenance standards (Productivity Commission 2000, p. G1; and Intergovernmental Working Group on Rail Safety 1993, pp. 12–15).

Other initiatives were thought to drive the industry towards greater consistency. One major initiative was the formation of National Rail Corporation (NRC). In 1991 the Industry Commission noted that the corporation's establishment, with its single management of interstate operations, would internalise any benefits from harmonised systems, and that this would therefore accelerate the process towards uniform standards.[73] As a result, the Commission indicated that 'Given these expectations, it would be inappropriate at this time to recommend the creation of a regulatory body for standards while the NRC is being established'. The Commission recommended that this (and other reforms) be reviewed within five years (IC 1991, p. 345).

71 We accept there is a degree of arbitrariness in this approach. NERA (2000, pp. 93-94) notes that safety regulations vary across EU Member States. This reflects, in part, differing views on what are technical or engineering issues and what are perceived to be 'safety' issues. As they note, however, in practice it is difficult to make clear distinctions as '...almost all equipment has some safety dimension'.

72 Now known as the Rail Safety Regulators Panel.

73 When the report was prepared, government plans were for National Rail to manage below-rail as well as above-rail interstate assets. However, this approach was reconsidered and management of much of the below-rail assets ended up with ARTC.

Subsequently, competition policy brought about multiple interstate operations though the unitary interstate railway operation did not eventuate. There was a subsequent call for further development of railway standards following the 1997 National Rail Summit of Australian governments. This spurred initiatives to facilitate rail operational harmonisation. For instance, the respective State and Federal authorities agreed to establish a process to facilitate harmonisation of operational practices and technical standards. This led to the establishment of the Australian Rail Operations Unit (AROU) in 1998. In 1999, the Unit's work was complemented by the establishment of an Inter-governmental Agreement on rail operational harmonisation. Until 2003, the Unit managed and facilitated the development of the Code of Practice. The Code Management Company (a subsidiary of the ARA) now administers and owns the code.

The Australian Transport Council considers that the codes offer the following advantages:

> Implementation of the Codes offers the opportunity to enhance the overall network performance by providing, on parts of the network:
>
> - improved transit times
> - lower infrastructure maintenance costs
> - increased train paths. (ATC 2000, pp. 19–20)

The code is consistent with the principles laid out in Australian Standard AS 4292, discussed in chapter 4. It encompasses operations, safeworking and infrastructure issues—track, civil and electrical issues, including signals & communications—and rolling stock.

The main spur to developing the Code has been to seek harmonisation where it is possible and practical, as well as seeking to provide an environment that is conducive to greater safety. Many of the code elements relate, directly or indirectly, to safety in infrastructure management and train operation. The Industry Reference Group commented thus, to the Productivity Commission:

> The codes address a range of operational uniformity issues many of which relate to safe operating practices and, consequently, the codes will provide rail organisations with a means with which to comply

> with the relevant parts of AS 4292. However, the codes are about more than just safety and were not developed as a form of safety regulation. (Industry Reference Group 1999, p. 4)

The Code sets out guidelines that are then embodied in 'operating procedures and standards' for the safe working on, or about, the infrastructure. These are intended to be developed as rule books that specify how the code's principles are to be applied.

In terms of its efficacy, it should be noted that the code is not a regulation—adoption is voluntary and the code is described as 'guidelines' for operations and technical standards. It is essentially a form of self-regulation.

However, there are two incentives to adopt standards from the code, where appropriate:

- Although it is voluntary, an infrastructure manager may require a train operator to adopt relevant codes as part of an infrastructure access contract (Affleck 2003, p. 23).[74] It is the train operators, in particular, who equip for, and adjust their operating procedures, when crossing infrastructure management boundaries. As users of the infrastructure who need to comply to varying terms of access or operating procedures, it is perhaps not surprising that 'rail operators in particular have a strong desire to see greater uniformity' (Affleck 2003, p. 29).
- Another incentive for firms to abide by the code is that compliance with it guides safety regulators, and this will inevitably influence their assessment of a firm's safety systems.[75] There are also some physical aspects of the code that are indicated as mandatory but these are '...designed to act only as compliance indicators. (Affleck 2002, p. 13) Where there are 'mandatory' requirements, they are not retrospective. Mandatory operational practices—notably, operational and safeworking systems—are not retrospective either. It is deemed practical and necessary to have a period of time in which to change the operational systems.

74 As discussed above (p. 56), in the 1880s the USA railways set similar requirements on movements of inter-system traffic.

75 For instance, adopting the Codes of Practice can ease the accreditor's task in assessing the applicant's risk profile. Further, if the licensed operator has adopted the code, and a safety incident occurs, it can assist the incident investigation.

In their 2001 report, ACIL Consulting reported comments from some industry players that to 'get political sign off', the Code '...exclude[d] things that are in the too hard basket' (ACIL 2001, p. 8). This may be a valid criticism but, nonetheless, the architects of the process intend the code to evolve. That is, the code should be developed—deepened and broadened—further. According to Affleck (2003), the Code Management Committee is likely to seek to broaden and deepen the code's coverage. Affleck argues that

> ...neither the Code of Practice nor the small number of other best-practice standards developed by the industry contain adequate guidelines for management of some key safety risk factors, in particular fatigue, alcohol and drug control, and medical fitness. (Affleck 2003, pp. 17–18)

While initially developed for the interstate network, the relevant stakeholders intend that it will eventually be applied across the entire network. That said, it is likely that the vastly differing operational and technical standards of the large urban railway systems reduces the likelihood that the code can be comprehensively applied.

Will the code be implemented? Will industry players actually adopt the code? The nature of the guidelines will influence the pace of implementation. For instance, where the code specifies physical standards, compliance with the standard will occur only as infrastructure is replaced. So, for long-lived assets, this may be a very long time. Before the code can be implemented, risk assessments and training processes must be completed. This means that even when the Code specifies guidelines on operating protocols, the process can be protracted.

We can conclude that the code process offers benchmarks and opportunities for the industry to set standards and, where appropriate, to adopt them. To the extent that standards on interfaces and protocols are fostered, the code enables a degree of customisation to be achieved without high bridging costs. The voluntary nature of the code ensures that firms are not required to adopt standards where customisation is more appropriate. However, infrastructure manager requirements and safety regulator accreditation processes do encourage adoption.

Technical diversity

This section considers technical standards, the extent to which they are non-optimal and how non-optimal standards affect the industry's operation. In his review of the railway industry, Affleck concludes that multiple technical standards impede productivity improvements and risk management:

> Non-uniform technical standards are a barrier to innovation and productivity improvement. There is no common starting point for innovation in relation to factors such as mass and dimension limits (axle-load and speed limits, train length and outline gauge), radio coverage and frequency allocations, and standards for track-side fault monitoring, equipment identification and data analysis. This significantly inhibits innovation. Risk management strategies of road and rail infrastructure owners for the design and operation of road-rail level crossings are also un-coordinated and inadequate in scope, and non-uniform between States.
>
> Put simply, the historic state-based systems of Australian rail systems have perpetuated non-uniformity, which continues to be a barrier to sound risk management, productivity improvement, innovation and effective competition. (Affleck 2003, p. 18)

As discussed elsewhere in the report, the practical consequences of diversity will be realised by the trade-off between any benefits from non-standard specifications and the bridging costs arising from that non-standardisation.

Track gauge

One of the most widely-acknowledged areas where diversity seriously affects railway performance is when different widths of railway gauge meet.[76] This technical differential produces an all-or-nothing

76 The gauge issue is not unique to railways. For instance, modern airports are designed around the specifications of the Boeing 747 jet aeroplane; thus, for instance, because departure gate spacings are based around the size of the 747s, wider wingspans (such as with the new Airbus A380 aircraft) can be accommodated only by reconfiguring airport terminals. Similarly, different specifications were adopted for the construction of freight canals in England-some adopted lock widths of 7' and others had widths of 14'. Similarly, there were different lock lengths. The consequence is that small narrow boats can traverse all locks but larger boats are width-and/or length-constrained.

outcome: if the gauge changes, the train cannot proceed.[77] The consequences of this form of differential are highly significant for railway operation. In essence, each cluster of common-gauge railway lines necessarily operates as an independent system. This is evident, in particular, with the narrow gauge lines of Queensland and Western Australia. Sometimes, the technical impact was very significant; for instance, Figure 3.1 illustrates the complex turnouts ('points') that had to be built in the Gladstone (South Australia) railway yards in order for wagons to be served by all three gauges that operated from or through the station yard.

3.1 Grain siding served by broad, standard and narrow gauges, Gladstone (SA)

77 A Spanish company has developed technology that automatically changes the spacing between the wheels as a train moves between different rail gauges; this is the 'Talgo' passenger train. In general, however, this breaks-of-gauge solution is impractical for widespread use (especially in freight movements) due to the capital costs and technical and operational compromises that need to be made.

For rail gauges, the loss of efficiency arising from having separate track networks generates additional costs. These extra costs form a substantial proportion of the total cost of using the rail mode, and are discussed below.

Bridging costs

The bridging between the gauges is significant. Bridging may involve trans-shipment of goods across wagons or the swapping of each wagon's bogies (wheel sets) from one gauge to another.

Duplicated locomotives and rolling stock

Duplicate locomotives, and sometimes wagons, are also required for each gauge.

Time cost

There is inevitably also a significant cost in terms of increased transit time.

Rail services have therefore tended to be confined within these smaller, common-gauge networks. Consequently, rail has not achieved its inherent advantages in moving freight over longer distances.

Do the remaining gauge-breaks matter?

While there remain three major track gauges in Australia, the interstate network is now set to one common gauge. The importance of the remaining gauge breaks is a function of the extent to which traffic flows across those breaks—whether by rail or by road.[78] This is illustrated in Table 3.1. It should also be noted that break-of-gauge could be a significant issue for the proposed Inland Railway link between Melbourne, Brisbane and Gladstone (Queensland).[79] Notably, the track on the corridor in NSW and Victoria is standard gauge. In Queensland it is narrow gauge.

78 ... while recognising that a break-of-gauge in itself is likely to suppress transport movement across the break point-and certainly suppress rail traffic across the break point.

79 ...with plans, ultimately, for a through link to Darwin via Mt Isa.

3.1 Break-of-gauge points on Australian rail network[a]

Location	*Gauge (mm)*		*Principal freight flow affected*
Brisbane	narrow	standard	Container traffic
Melbourne to Albury-Wodonga	standard	broad	Break-of-gauge between broad gauge lines (such as Oaklands, Tocumwal, Echuca via Mangalore) and standard gauge line. Grain produce flows to Melbourne via broad gauge line adjacent to standard gauge line; no apparent need for onwards flow on standard gauge[b].
Melbourne	standard	broad	Steel train flows between Hastings (Western Port) and Port Kembla and other locations
Dunolly (Victoria)	standard	broad	Broad gauge grain traffic to Geelong; standard gauge grain traffic to Portland or Geelong. Proposed mineral sands traffic prevented from flowing to preferred port at Portland, owing to break-of-gauge at Dunolly/Maryborough.
Pinnaroo (SA)/Panitya (Victoria)	standard	broad	Break of gauge from 1995, ending this diversionary route for intermodal traffic; Victorian grain traffic must go via Portland rather than via Pinnaroo/Port Adelaide
Wolseley (SA) and Heywood (Victoria)	standard	broad	Break of gauge from 1995, ending common gauge access to Mt Gambier; affects general cargo and goods exported via Portland
Mid-north SA	broad	standard	Break-of-gauge at Salisbury; mid-north traffic (largely grain) has access to Port Adelaide but no access beyond on interstate network
Whyalla (SA)	narrow	standard	Iron ores from Middleback Ranges are exported from Whyalla or processed in Whyalla before onwards movement. That is, traffic is not trans-shipped across the gauge break.
Merredin (WA)	narrow	standard	Grain transfer facility available as well as indirect narrow gauge routes to Perth.
Northam (WA)	narrow	standard	Both narrow and standard (dual) gauge access to Perth, Fremantle and Kwinana. Principally grain traffic.

(a) This table excludes the break-of-gauge at Wallangarra (on the NSW–Queensland border) as the Glen Innes–Wallangarra standard-gauge line is not used.

(b) It is planned that these lines will be converted to standard gauge, along with the Albury–Melbourne broad-gauge line.

The following table lists the break-of-gauge points on the rail network. Note that the Victorian government intends to convert much of its remaining broad gauge track to standard gauge.

Most of these locations involve negligible goods movements across the break, or traffic that has relatively low bridging costs. Probably the largest task involves the steel movements between the BlueScope steel mill at Hastings (Western Port) and locations in other States. They typically involve goods transfers to and from broad gauge at the nearby Melbourne Steel Terminal, as illustrated in Figure 1.7. BHP Steel (2003, p. 2) indicated that it needs to switch 500 000 tonnes of steel across gauges at the Melbourne terminal. This transfer is eased through the extensive use of containers, shifted between broad and standard gauge wagons with gantry cranes.[80]

In some cases, such as Whyalla, the goods incur further processing so that the break-of-gauge is irrelevant. The iron ore that arrives via the narrow gauge is processed into steel before onwards movement on standard gauge. Similarly, in the case of Brisbane gauge break, much of the north-bound traffic is re-bundled to reflect the lower volumes of goods required beyond the capital city. In any case, many of the goods moving across this break are moved in containers, which incur relatively low bridging costs. Of the other breaks, Northam has both standard—and narrow-gauge access to Perth. There are considerable grain flows across the gauge-break at Merredin but the bridging costs are relatively low following the installation of mechanised equipment. This is a contrast with the largely-manual grab-crane system illustrated in Figure 1.6 that was used into the 1980s.[81]

The aggregate bridging costs arising from the remaining gauge breaks are 'low' for two reasons:

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80 If the port of Western Port/Hastings is further developed, the gauge break may be an increased impediment to rail traffic that would otherwise move beyond Melbourne on the standard gauge system.

81 When standard gauge track was installed between Kalgoorlie and Perth, a grain transfer terminal was constructed at Merredin; this reduced the impact of the new gauge-break by reducing the bridging costs arising from the transfer of grain across the break.

- the volume of traffic that is, or potentially would need to be, trans-shipped, is relatively low; and
- containerisation of the goods and mechanisation of grain transfer decreases the unit bridging costs.

That is, the remaining breaks-of-gauge on the intercity system do not have a significant bearing on the freight logistics task.

Rolling stock

The Industry Commission reported in 1991 that, even where common gauge was provided, it was not possible to operate rolling stock unrestricted across the entire network. There are several reasons for this, which are discussed in the capacity discussion, below. They include the strength of the wagon and the restrictions on the maximum axle load on the track—as illustrated by the map in Appendix III.

Generally, there are two triggers for restrictions on rolling stock movements. They are the customisation of rolling stock to reflect specific goods-carrying needs and circumstances where standardised specifications could have extended the area where rolling stock could be used. The development of Volume 5 of the Code of Practice will reduce unnecessary non-standardisation. The code is discussed in more detail later in this chapter.

There is a regulatory aspect of this rolling stock diversity that has relevance here. In its 1991 study, the Industry Commission noted that there were circumstances where it was technically possible—but not permitted—for rolling stock of one railway to operate on another system. Similarly, the Intergovernmental Working Group on Rail Safety reported examples of standards being applied inconsistently. For example, one rail manager permitted a certain maximum speed for given wagon bogies but other managers permitted a higher speed. In another example, flat wagons on one rail system were limited to 80 km/h but not restricted elsewhere (Intergovernmental Working Group on Rail Safety 1993, p. 10).

The Industry Commission called for mutual recognition of rolling stock. Such a system would then ensure that 'non-standard' stock was able to operate on other systems so long as physical and safety conditions permitted. The commission called for uniformity and minimum standards that would facilitate the grading of stock into track classifications that would enable the wagons to be operated on the same track classifications on other operators' tracks (Industry Commission 1991, p. 338). Again, the development of the Code of Practice on rolling stock will facilitate this process.

Capacity

Railway capacity can be considered in three primary components: train, track and terminal capacity. For ease of reading, the consequences of diversity in each component are now considered, separately. In practice, however, the authors accept that '...greater benefits and a much broader insight into the industry as a whole can be gained if [train] operational issues are considered in parallel with any infrastructure assessment' (BTCE 1995, p. 64).

Train capacity

Train capacity is a function of three primary factors:

- the loading outline of the infrastructure;
- the axle load permitted on the track; and
- the maximum weight of the train that is permitted.

In principle, train capacity is also a function of the maximum train length. This, however, is a function of track capacity, which is discussed below.

Loading outline

The loading outline is the measurement of the clearance of lineside structures. This determines the maximum dimensions allowed for rolling stock. Loading outline is an important parameter in wagon and, thus, train capacity. Therefore, it is important in the overall equation of railway economics. Loading outline is the envelope of safe, that is, operational, height and width dimensions of railway vehicles. For a given route, this envelope is defined by the smallest available dimensions. For instance, if the maximum height, or clearance, is 5.5 metres measured from the top of the rail, then irrespective of clearances elsewhere on the route, no wagons may exceed those dimensions.

The principal overhead constraints arise from tunnels, overhead bridges, signals and catenary (wires feeding power to electric locomotives). Major lateral constraints include the vicinity of adjacent railway tracks (that is, the spacing between the tracks), signalling equipment, tunnel and bridge structures and station platform edges. The cost of raising/widening the clearance is relatively modest for signals and clearances around platform edges; at the other extreme, enlargement of tunnels and increasing clearance around bridges is relatively costly.

Loading outline is always a relevant issue in the diversity of the provision of railway infrastructure. However, the increase in unitisation of freight and, particularly, the development and subsequent widespread adoption of containers,[82] increased focus on the loading outline. Figure 3.2 illustrates container movement on railways.

3.2 ISO 40 ft and 20 ft international containers on rail flat wagons

Source: Mark Carter, GRMS *MEDIA*.

The establishment of international standard ISO TC104 for container dimensions, and other characteristics, was an important development because of the strong handling economies that accrue when adopting

82 The container was developed by Sea-Land Services Inc. of New Jersey in 1956.

consistent technical features. Standard-sized containers enabled bundles of goods—moving between the same general origins and destinations—to be moved as one unit of goods. This meant that goods could be moved without intermediate trans-shipment between or within modes. Given existing ship, road and rail dimensions, there were some compromises in establishing suitable container sizes that could be operated by each mode and across an extensive geographical area of the world.

To achieve the substantial handling economies that containers provide over non-unitised goods, containers must be constructed to very limited dimensions. Some containers have been constructed purely for domestic use and do not necessarily conform to all international standards. International (ISO)[83] containers are largely built to a width of 8 feet and a height of 8 foot 6 inches or the 'high cube' height of 9 foot 6 inches.[84] Table 3.2 provides illustrative specifications for the main container specifications.[85] There are non-linear limits of structural strength of the container as the size increases. Consequently, doubling the length of these containers brings only a modest increase in payload. The primary utility of such containers is having goods that volume out before they mass out—that is, they fill up the available space in the container before they reach their weight limit.[86]

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83 International Organization for Standardization.

84 The original ISO standard container was 20' length x 8' width x 8' high. The 8' 6" (2.591 m) high container is known as the ISO standard container while the 9' 6" (2.896 m) high container is known as the 'high cube container'. The 8' (2.438 m) width has, in some circumstances (notably, Continental Europe), been eased outwards to 2.55 metres, to enable placement of two pallets across the container (with tolerances and allowing for the metal frame of the container itself). A similar consideration led to the development of the Railways of Australia Container Express (RACE) containers, which were introduced in the 1970s. They were wider than standard ISO containers but their use enabled them to take Australian standard pallets efficiently.

85 These specifications can vary with the strength of the material used and the form of the structure.

86 The containers themselves weigh between 2 and 4 tonnes. A standard flat rail wagon with a single layer of two 20 foot containers will therefore take a maximum payload of around 21.6 times 2 = 43.2 tonnes. By contrast, a conventional rail louvre wagon, with a profile that follows the railway loading outline, will have extra internal volume to take additional goods. That is, while the container provides superior flexibility in door-to-door capabilities, the conventional wagon can (subject to rail axle load/wagon mass limits) carry significantly greater loads. For instance, the louvre wagons used by SCT can carry a maximum payload of 49 tonnes.

3.2 Container specifications (illustrative only)

Parameter	*Standard 8′6″ container*		*9′6″ hi-cube*	
Height	8 feet 6 inches (2.591m)		9 feet 6 inches (2.896m)	
Width	8 feet (2.438m)		8 feet (2.438m)	
Length	20′ (6.1m)	40′ (12.2m)	20′ (6.1m)	40′ (12.2m)
Weight of container (tare)	2.2 tonnes	3.7 tonnes	2.4 tonnes	3.9 tonnes
Net tonnage (payload)*	24.8 tonnes	28.8 tonnes	28.0 tonnes	28.6 tonnes

Note: *The payload can vary considerably, depending on the strength of the container. EC 1999 (p. 62) explains how some European railway containers were built to standard dimensions but, for ease of work in railway terminals, were built with side doors (rather than end-doors). This placement of doors weakens the overall strength of the containers, thereby reducing the maximum allowable payload.

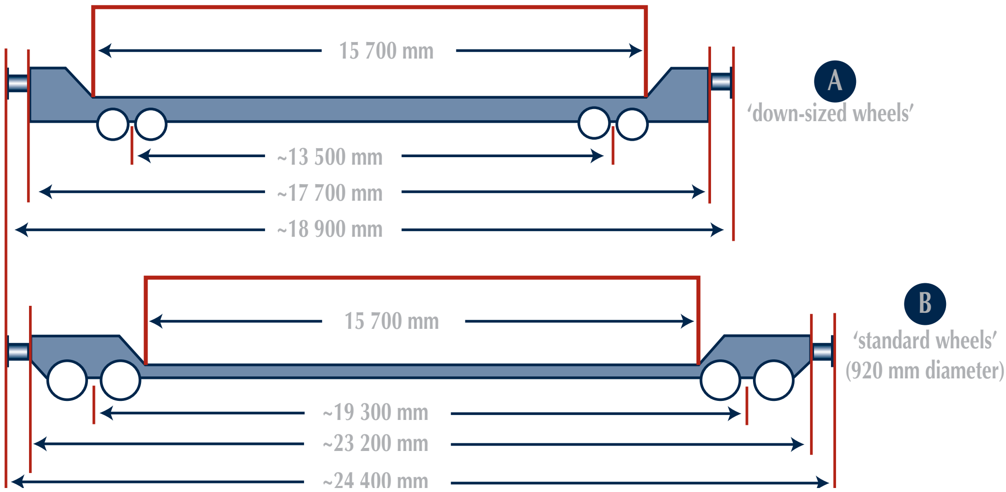
There is no practical problem with having a broad range of loading outlines. However, the container revolution has magnified the possible limitations of the smallest possible loading outline envelope. This is because the smallest loading outline on a given railway route has a pervasive effect on the railway capacity. That loading outline provides the envelope—the constraints—on what formation and type of containers can be carried on a given route. Thus, the smallest loading outline envelope defines whether these containers (loaded on wagons) can be transported along a railway.

There are ways of bridging the constraint within the existing loading outline,[87] though this additional capacity comes at a cost. The two primary options are wheel size and deck height.

Using small wheels—see item A in Figure 3.3—can lower the deck height on the wagon, reducing the required clearance above the rail. However, there is a trade-off in using these wheels. They increase wheel-rail stresses significantly relative to conventionally-sized wheels. This can be compensated for by lowering the maximum axle load, though this usually means that payload has to be reduced. For more information about wheel size impacts, see the European Commission's 1999 report 1999 (p. 113).

87 The required minimum loading outline is based on the combined height of the trackbed, the height of the container and the deck height of the wagon on which the container is placed. This is the static measurement of the trackbed+wagon; further allowance is made for the movement envelope of the wagon+container that arises when the wagon is moved (that is, the dynamic envelope). The deck height of a conventional flat wagon may be around 1.1 metres (Maunsell 2003, p. 41). With an 8′ 6″ (2.591 m) container, this means a need for a minimum clearance above the rail of around 3.7 m plus an allowance for the dynamic envelope.

3.3 Options for fitting high containers in well wagons



Source: European Commission (1999, p. 113).

The deck height can also be lowered by slinging the deck between—rather than on top of—the two sets of wheel bogies, as illustrated in B in Figure 3.3. The trade-off here is that the well wagons reduce wagon capacity as single-tier containers are contained within the well. So, because the containers are no longer riding over the wheel sets, then within a given length of train, there is less payload.

A third option for increasing loading outline is possible. However, because it requires double track, it could not be applied in most situations of Australia's largely single-track network.[88] This option can be used where there is double track going through low arched tunnels and arched bridges. A third railway track can be placed in the middle of a double-track alignment. Here the main cost arises from the reduced line capacity as the line is effectively reduced to single track.

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88 Around one-half of the track between Sydney and Melbourne is double-track whereas only around one-fifth of the Brisbane-Sydney route is double-track (ARTC 2005, pp. 12, 14).

3.4 **Double-stacking (using a well wagon) in Australia**

Source: Mark Carter, GRMS*MEDIA*.

In some cases, the loading outline clearance is sufficient to enable a container to be stacked on top of a second container. However, such practices require careful consideration of centre-of-gravity and container strength—see Figure 3.4 and Figure 3.5. At its most uninhibited, this 'double-stacking' may be defined as one 9′6″ container stacked on top of a second 9′6″ container, placed on a conventional flat wagon. In the absence of this clearance, well wagons may be used. Double-stacking can enable a greater volume of goods for a given train length, facilitating economies of density in train operation.

Should variable loading outlines be standardised?

As with railway gauge, Australia's railway builders set varying dimensions to the loading outline. By the time a common technical standard on loading outline was agreed in 1906, most of the primary railways had been built (Australian Heritage Commission 2003). The inherited loading outlines would have been a parameter determining Railways of Australia's specifications for the interstate wagon fleets—see above, page 16.

The primary issue with loading outline constraints across the rail network is the pinch points that can prevent, not just inhibit, certain types of wagon configurations. Generally, loading outline width is not an issue. For instance, on the ARTC network, the maximum permissible wagonload gauge width is 2.5 metres. This exceeds the standard container width, which is 8′ or 2.438 metres.

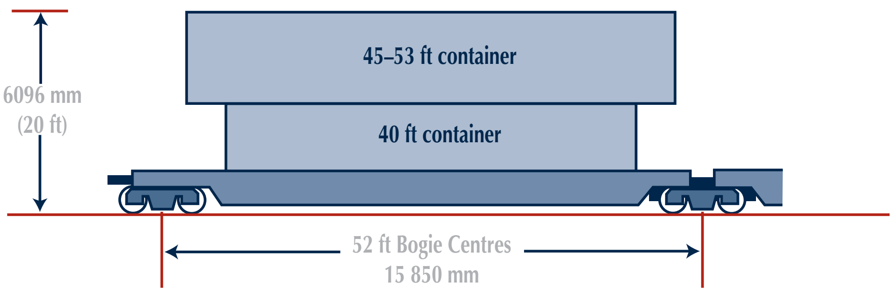
There are no major loading outline problems on the primary Australian railway network when using the current standard heights of 8′6″ and 9′6″, on a single stack. However, there are two issues with railway loading outline in conveying containers:

- if the maximum container height is increased; and
- if train operators seek to achieve potential economies through double-stacking the containers.

The maximum container height would become an issue if 10′6″ (3.20 metres) high 'maxicube' containers became prevalent in the international market. If this eventuated, it would come from North America rather than Europe. The North Americans generally have a more generous clearance on their roads and railways whereas the European gauges have similar dimensions to Australia's. Figure 3.6 illustrates the loading outline clearances on the interstate network. Currently, because the 10′6″ containers require a loading outline of 4.25 metres, these containers can be run only on the east-west corridor using conventional wagons. In July 2005, ARTC announced an investment of $40 million to increase the minimum loading clearance between Brisbane and Melbourne. This will enable 10′6″ containers to run on this corridor using conventional wagons. (ARTC 2005a, p. 6)

Double-stacking containers offers potential economies in railway operation but the ability to double-stack depends on the loading outline. In principle, double-stacking containers can lead to cost savings by increasing the payload per wagon. That is, the train's

3.5 Illustration of double-stacking with well wagons in USA



US Double Stack Container Car

Source: Railway technical web pages, <http://www.trainweb.org/railwaytechnical/eole.htm>

payload to tare weight is increased. This can mean lower fuel and wagon operating costs per net tonne although double-stacking increases train assembly costs at terminals.

The loading outline on much of the Australian interstate system prevents double-stacking. In any case, interstate track does not permit double-stacking of 9′6″ containers on flat wagons. Here the 9′6″ containers are set within a well wagon. In most cases, the easy/justifiable height clearances have already been undertaken to enable double-stacking. An example of this is Adelaide–Perth, where double-stacking of 9′6″ containers in well wagons is possible.

In some cases, relatively minor remedial work on isolated height bottlenecks can lead to significant capacity opportunities. For example, bridge-clearance work in the vicinity of Port Augusta in recent years has improved double-stacking capabilities for freight moving between Adelaide/Crystal Brook and Perth. Double-stacking is also possible between Parkes and Crystal Brook. However, the 5.85m height restriction on this route provides less flexibility. As before, a standard well wagon is used. However, instead of stacking two 9′6″ containers, the route is restricted to stacking one 8′6″ container with a 9′6″ container. There is a limited number of low structures and it is relatively inexpensive to enlarge the clearances.

3.6 Loading outline height above rail on the interstate network

Thus, ARTC does not need to spend much money to enable double-stacking of two, 9′6″ containers. This clearance would therefore enable double-stacking between Parkes and Perth.[89]

However, there are significant parts of the network where loading outline does not permit double stacking—see Figure 3.6—and where significant expenditure is required to realise the full potential of double-stacking. For instance, on the Melbourne–Adelaide route, there are 218 signal overhead obstructions and 573 other minor obstructions. In addition to these, there are an additional 229 'significant' obstructions, such as railway tunnels in the Adelaide

89 See ARTC 2004, which provides a cost estimate of $21 million for clearance on the Parkes-Broken Hill line. By contrast, Maunsell (2003, p. 17) quotes a 1995 study that estimated the cost of clearance for double-stacking on the Melbourne-Adelaide line of $111 million.

Hills. Further, the overhead electrical wires—such as used by urban/interurban commuter trains on mixed passenger/freight lines in the Greater Sydney area—leave insufficient clearance for double-stacking. The cost for raising the loading outline here has been estimated at one billion dollars. Maunsell's analysis of a range of double-stacking options found benefit-cost ratios of well below one. That is, the benefits do not support investing in raising the loading outline (Maunsell 2003, Appendix D).

Given these costs and the current traffic levels, the benefits are usually not sufficient to provide a financial, or even economic, case for investing in raising the loading outline. This financial case was illustrated in Figure 2.4. In these situations, at best, any expenditure on raising the loading outline might only be justified when expenditure on the structure enables the clearance to be raised at a relatively low cost. In this context, the ARA's Code of Practice sets the 7.1 metre standard height only for situations where the infrastructure is being built or rebuilt. This standard presumes that the incremental cost of the higher clearance is not significant.

A final important aspect of loading outline consistency is that the benefits arising from the standard may not be realised without consistency in other, complementary, infrastructure standards. The terminal technology and layout need to be able to readily cater for double-stacking. For example, greater care is needed in the placement of containers on wagons. Even with this, there is a risk that the terminal costs arising from double-stacking will outweigh the train capacity benefits.

Another important aspect of consistency across standards is that, depending on the mass of goods carried, double-stacked wagons may need infrastructure that can take relatively high axle loads.[90] This is not an issue on main lines in North America, where widespread use of double-stacking offers an alluring example for Australia. The axle loads on North American main lines are typically over 30 tonnes per axle. However, the typical axle load on Australian main lines is

90 For instance, containers on Pacific National's Adelaide-Port Melbourne service carry mostly wine; the relatively heavy goods on this service lead to the containers reaching the wagon's axle load limit before the volume of the container is filled. While it may be possible to load the wagon to work within the low axle load-such that a heavy container is matched by a light container-there can be additional terminal costs resulting from the extra activity required to match heavy and light containers. Other goods that have relatively high weight include grain, at 15-21 tonnes per TEU. This is not necessarily an issue for international containers. Import containers average around 9-10 tonnes/TEU and export containers average 12-14 tonnes/TEU. With a wagon of around 25 tonnes and double-stacked 20' long containers of 14 tonnes, the axle load would approximate 20 tonnes/axle.

19 tonnes to 21 tonnes. This can severely constrain the payload for a double-stacked wagon. For example, Maunsell (2003, p. 40) reported that double-stacked 20 foot containers, loaded to their full gross load limit, would exceed both the 21 tonne and 25 tonne axle loads.[91] Thus, capturing the benefits of a common, or large, loading outline relies on other infrastructure standards also being high. The technical standards required in Australia are low compared to the United States with its high traffic volumes. This will tend to rule out any significant investment undertaken for the purpose of gauge enhancement.

Axle loads

For train operators, achieving a 'high' axle load is an important parameter in the efficiency of train operations. In particular, the higher the net load of goods relative to the empty (or tare) wagon weight, the greater is the inherent efficiency. The efficiencies arise through:

- **Capital costs**—less wagons are needed to move a given level of traffic;
- **Fuel consumption**—higher payload to tare weight reduces fuel consumption per unit of payload;
- **Crew costs**—in principle, fewer wagons means fewer trains operated; and
- **Locomotive costs**—the net-tare ratio can be improved for a given level of locomotive usage.

The axle load that an infrastructure manager will permit on a given section of track will depend upon a range of infrastructure and train factors, including the:

- condition of the rail, sleepers and track bed—determined, in part by maintenance regime and age of assets;

91 There can be a degree of latitude in the rail weight-axle load relationship. For a given rail weight and a given train speed, higher axle loads can be sustained if a more intense maintenance regime is adopted. For example, higher axle loads may be possible where there are higher frequencies of rail grinding and track tamping and higher standards of trackside drainage.

- frequency of rail joints—at its ultimate, being continuously welded into long lengths;
- intensity of maintenance on the track;
- weight of rail;
- spacing and type of sleepers;
- depth and shoulder width of ballast;
- speed of the train; and
- type of wagon bogies used—which affects the dynamic load on the rail surface.

Note that the axle load is an important parameter that determines track wear-and-tear. In reality, for a given axle load, the wear-and-tear also varies according to how the wagon rides on the track. This ride quality is a function of the type of bogie and the specification and condition of the wheel sets. It determines the dynamic loads, which determine the actual wear-and-tear.

An important, related, link here is between the dynamic load on the track and the speed of the train. In particular, other things being equal, the physical impact of the wagon on the track is reduced as train speed is reduced. Consequently, higher axle loads are possible when the train speed is reduced.

As a consequence of this relationship, it is possible to compensate, to some extent, for track that has a relatively low axle load, by reducing the train speed. Further, there is latitude for increasing axle loads by increasing the intensity of maintenance—rather than having to replace the track with a higher specification rail or sleeper. Of course, there is a trade-off between the longer transit times/higher maintenance costs that arise from heavier axle loads, and the enhanced train efficiencies that arise from operating wagons with higher axle loads.

Is variable axle load an impediment to operational efficiency?

In the United States and Canada, the large Class I railways have progressively rebuilt their railways to increase their axle loads. This rebuilding programme focused on track—that is, ballast depth, drainage and rail weight-and bridges). It enabled heavier 286 000 pound wagons (that is, around 32 tonne axle loads) to run on their tracks. Smaller, branch line and regional railway operators have not had the financial returns to follow this rebuilding process.[92] Consequently, these latter operators often cannot carry fully-laden new wagons. Inevitably, this undermines the viability of the smaller railway operators. They cannot capture the main line efficiencies and they may not be able to handle the heavier wagons–see Zarembski 2000.

For any given train speed, axle load limits vary across the Australian interstate rail network. But, given the low traffic levels relative to the United States, axle loads are generally no greater than 23 tonnes. Axle load specifications may also reflect the fact that other infrastructure standards are also set low. On some tracks, axle loads are set low or constrained because the line was built to a narrow railway gauge and/or because bridge strengths are relatively low. In these circumstances, a less-expensive, light, rail weight, with a low axle load, is suitable.

Other things being equal, the weight of rail is an important determinant of the permitted axle load. As noted above, however, there are complementary and ancillary factors that influence the decision on the permitted axle load/speed relationship. For example, in 1998, Koolyanobbing–Avon had the heaviest rail weight—60 kilograms per metre of rail—on the interstate network. Its speed limit was 90 km/h for 21-tonne axle load wagons. This was lower than some interstate track—for example, Broken Hill–Crystal Brook, with a rail weight of 47 Kilograms per metre of rail. This is illustrated in Table 3.3.

As noted earlier, an important element of the axle load/speed relationship is that the sum of the different components of the track bed and the rolling stock give a smooth ride. Thus, to some extent, good or well-synchronised maintenance of these components can deliver the track-riding qualities that enable increases in axle loads that might otherwise need higher specification components.

The effect of such maintenance regimes is illustrated in Table 3.3. Here a crude overview is provided of the relationship between the

92 See, for instance, Babcock and Sanderson (2004, p. 24), for a case study on regional railways in Kansas and the problem of inadequate returns for uplifting axle loads to handle 286 000 lb wagons.

3.3 Rail weights, permitted intermodal train speeds and axle lines, interstate lines

Section	*Rail weight (kg per metre)*	*Permitted train speed (kph)*		*Axle load (tonnes)*
		In 1998	In 2005	
Acacia Ridge-Qld border	53	100	100	21
Qld border-Sydney	53	115	100	21
Sydney-Broken Hill	53	115	10021	
Broken Hill-Crystal Brook	47	110	110	21
Sydney-Albury	53	115	100	21
Albury-Melbourne	47	80 (@ 20 tonne)	110	21
Melbourne-Wolseley	47	80 (@ 20 tonne)	110	21
Wolseley-Adelaide	47	110	110	21
Adelaide-Kalgoorlie	47	110	110	21
Kalgoorlie-Koolyanobbing	47	80	80/115	21
Koolyanobbing-Avon	60	90	110	21

Source: Data are from Maunsell (1998, Table 6.1, p. 60). Updated from data in ARTC 2001a; Economic Regulation Authority 2004, Table 2; ARA 2001, Table 5.

Note: Although these different studies cite single rail weights for these sections of track, it does not preclude other rail weights being used on sections of the track. For instance, BAH 2001, p. 8, refers to 60kg rail on parts of the Wodonga (Albury)–Melbourne line.

axle load, rail weight and train speed on the interstate network, This table illustrates the relationship with limits for axle loads of 21 tonnes. Between 1998 and 2001, ARTC worked on restoring the consistency in smooth riding of wagons on the Albury–Melbourne line, based on using existing rail and track bed. This restoration enabled ARTC to raise axle loads and track speeds on its interstate lines, as presented in the table.

There is similar divergence in axle loads elsewhere on the network. For example, some branch lines in NSW are classified as 'restricted lines'. These lines typically inherit the relatively light rails installed when the lines were constructed. Rails may also be inherited as second-hand track displaced from main lines. Consequently, the lines have very restricted use with modern railway rolling stock. For instance, it is not possible to use main line locomotives or fully-loaded modern grain hopper wagons on these lines.[93] Thus, these

93 Similar issues arise in other rail systems. In the United States, for example, main lines are capable of 32-tonne axle loads and wagons have been built accordingly. However, a number of branch lines are not capable of taking these wagons. See, for instance, American Short Line and Regional Railroad Association 2000.

tracks are '...able to carry only partly loaded trains and light axle load locomotives at low speeds' (Grain Infrastructure Advisory Committee 2004, p. 8).[94]

Diversity does not, in itself, prevent freight movement. But it can set a relatively low standard that can undermine the benefit of using modern, heavier wagons. The infrastructure manager may be able to accept heavier axle loads by lowering track speeds, but this can lead to uncompetitive transit times.[95] As elsewhere, we note that the merits of upgrading need to be subject to the usual cost-benefit analysis. It is also important to note, however, that more intensive maintenance can also achieve higher axle load/speed standards. There are different approaches to achieving higher axle load/speed. This trade-off lends weight to the argument that performance standards be used instead of prescriptive standards on inputs.

Train weight (trailing load)

Train weight limits constrain train payload and require the use of additional locomotives. The constraint arises primarily from significant gradients, which can be exacerbated by tight curves on the track. The steepest gradient on a line segment—the ruling gradient—is the key factor in train weight limits. Table 3.4 illustrates the ruling gradients on line segments on the interstate systems.

The gradient affects train weight limits in two ways.[96] First, the line grade can restrict the allowable trailing gross tonnage to the amount

94 See, also, the axle load map prepared by QR Network Access (Network Access 2004)-see Appendix III. See Economic Regulation Authority (2004, Table 2) for the varying axle loads on Western Australia's narrow gauge.

95 For instance, upgrading of restricted lines in NSW includes replacing 1 in 4 sleepers on straight lines, leading to a maximum empty wagon speed of 50 km/h or loaded wagon speed of 30 km/h. A higher track renewal rate (such as replacing 1 in 2 sleepers and more ballast) could lead to an empty wagon speed of 80 km/h or loaded wagon speed of 50 km/h. See Grain Infrastructure Advisory Committee, p. 18).

96 By way of example, the Inter-State Commission (1987, p. 71) identifies three sources of limit on the trailing load between Sydney and Broken Hill: (a) a limit to the maximum electrical power that can be supplied to electric locomotives between Sydney and Lithgow [but now overcome through use of higher-powered diesel-electrics]; (b) limits due to the maximum diesel-electric locomotive power [a problem overcome with the introduction of the NR-class locomotive]; and (c) limits dues to drawbar strength. The Commission notes that devices such as 'Locotrol' can be used to place locomotives at positions other than at the front of the train and that this can then reduce the drawbar loads though, at the time of the writing of the report, the system was not proven (Ibid., pp. 274-75).

3.4 Ruling gradients on interstate network

Line segment	*Ruling gradient* [a]
Brisbane–Sydney	1 in 50
Sydney–Parkes	1 in 33
Parkes–Crystal Brook	1 in 50
Sydney–Melbourne	1 in 40
Melbourne–Adelaide	1 in 45
Adelaide–Crystal Brook-Kalgoorlie	1 in 80
Kalgoorlie–Perth	1 in 150

Source: Maunsell 1998, p. 46; BTCE 1995, p. 21.

Note: a The ruling grade reflects the degree of incline. For example, a 1 in 50 gradient would mean that the track elevation changes one metre in height for every 50 metres in horizontal track length. The ruling gradient is sometimes reported as a percentage, e.g., 1 in 50 is a 2% ruling grade.

of weight that a train can carry as a result of its braking capacity. Severe gradients require braking power but train braking effectiveness declines as the number of wagons increases—hence the need to restrict train length. Secondly, the line grade can restrict loads/train lengths due to the wagons' drawbar.[97]

On interstate routes, constraints are through the Adelaide Hills, through the Blue Mountains, between Kalgoorlie and Kwinana and on the West Footscray–Albury line. The ramifications are absolute constraints, as follows:

- For the Adelaide–Tailem Bend section of the Melbourne line, the maximum permitted trailing load is 5 000 tonnes. This places an effective limit on high-mass trains approaching the 1 800 metre maximum train length.
- Constraints exist on the Blue Mountains line, limiting the train length to 1 100 metres between Sydney and Lithgow.
- Between Kalgoorlie and Kwinana there is an unconditional maximum of 5 000 tonnes on the line.
- On the Melbourne–Albury line, the maximum permitted trailing load is 4 500 tonnes. (ARTC 2001, p. 23)

Even where these caps on train capacity are not in place, severe gradients and curvatures require additional locomotives to haul the

97 The drawbar is part of the coupling system that links wagons. See glossary.

freight. This impacts on the train economics, by increasing the operating costs per revenue tonne hauled. A primary factor that determines the number of locomotives needed is the ruling grade on a line.[98] Unless the line is built to a high engineering standard, this will closely reflect the terrain.[99] The ARTC provides information on horsepower requirements as guidance for train operators. This is shown in Table 3.5.

3.5 Impact of ruling grade on locomotive power requirements (recommended horsepower needed per tonne)

Line segment on ARTC-managed track	*Class (speed) of train*			*No. of NR-class locos[a] for 5 000 tonne trailing load*		
	Premium	**High**	**Standard**	**Premium**	**High**	**Standard**
Adelaide-Parkeston	2.1	2.0	1.6	3	3	2
Crystal Brook-Broken Hill	2.1	2.0	1.7	3	3	3
Adelaide-Tailem Bend	3.0	3.0	3.0	4	4	4
Tailem Bend-Melbourne	2.0	2.0	2.0	3	3	3
Melbourne-Albury	2.1	2.0	1.7	3	3	3

a. Pacific National 'NR-class' locomotives are rated at approximately 4 000 horsepower.

Source: ARTC 2003.

Apart from the need to operate with additional locomotives, the steep grades affect the placement of wagons within a train. A wagon needs to take the strain of successive wagons so less robust wagons need to be positioned so that they take relatively less strain.[100] This can affect train efficiency by requiring additional shunting in terminals.

98 Train operators may choose (or infrastructure managers may require) additional locomotives for other reasons, including having reserve power in case a locomotive fails.

99 A line may have short, very steep sections of track. These may be ignored if, in normal operation, they do not inhibit the tonnage that can be hauled. Note that 'ruling grade' does not allow for the additional drag of the train that arises from curved track. The 'compensated grade' measurement allows for curvature.

100 If wagons are 'strong', the braking power limitations can be offset in various ways (that is, at a capital cost and with additional operating costs). For instance, it is possible to intersperse remotely-controlled locomotives within a train formation (that is, remote from the leading locomotives); this can be used to improve train handling dynamics, including maintaining air brake pressure.

To what extent do varying trailing loads hamper train operation?

The maximum trailing load prevailing at any section of track will determine the maximum trailing load on the route itself. Thus the route maximum is determined by the maximum on the worst section of the route.

To some extent, such trailing load constraints, and the need for supplementary locomotive power, can be circumvented. Train operating options include improving the wagon standards—such as their braking power and the strength of the wagon structure. Placement of locomotives within the train (in the middle or as a rear 'banking' locomotive) also provides operational advantages. On some sections of the network it is possible to avoid a steep gradient. But this comes at a cost. The route is more circuitous and there are distance and time penalties. Thus, for instance, most Broken Hill—routed freight (bound for Perth) transits via Cootamundra to avoid the more direct, but steeper, Blue Mountains route via Lithgow.[101] This route overcomes the weight limit and reduces the number of locomotives required.

There is only one alternative routeing for trains through the Adelaide Hills. Trains between Melbourne and Perth can travel via Albury–Cootamundra–Broken Hill. Here, however, the benefits from releasing train capacity constraints are more than offset by the higher costs from the circuitous route and the loss in competitiveness due to the extra journey time. Apart from re-routeing the railway line away from the Adelaide Hills—the value of which would necessarily be subject to cost-benefit analysis—there are no other alternatives. Some compensation is possible by operating a Perth-bound weight-limited train from Melbourne and adding additional wagons in Adelaide. This is undertaken with SCT Logistics trains.[102]

101 That is via the Main South line to Cootamundra, then to Parkes (on the Broken Hill-Perth line) via the Stockinbingal-Parkes line.

102 The train consist from Melbourne is around 50 wagons (each having a gross load of about 80 tonnes). Up to 20 additional wagons are then added for the section west of Adelaide-that is, beyond the trailing load-limited area of the Adelaide Hills-and double-stacking will also occur from this point onwards (with the higher maximum loading outline).

Track capacity

Available track capacity on the rail network varies considerably. The Australian network is dominated by single-track routes but has some sections of double-track, They are Maitland–Sydney–Junee on the north–south corridor and Avon–Perth (Midland) on the east–west corridor. Consequently, line capacity is essentially constrained by passing loop characteristics. Three primary factors determine capacity on single track:

- frequency of passing loops;
- journey time between those loops; and
- maximum train lengths permitted on the line—which is a function of passing loop length and track gradients/trailing load.

Other factors that influence track capacity, such as signalling and communications systems, are discussed later in this chapter. The efficiency of these systems can be a significant factor in determining track capacity. These systems can determine the spacing between trains travelling in the same direction and how efficiently—minimal time and effort—trains going in opposite directions can pass each other.

Generally, the level of track capacity that is provided should reflect the need for that capacity. Thus, beyond the bare minimum single track, the need for additional capacity will be determined by the level of traffic on the line and on where the trains are likely to cross.[103] If additional capacity is required, it can be provided by constructing additional and/or lengthened passing loops. Consequently, there will not be a formula on loop length, frequency or elapsed time between loops.

Finally, before considering other capacity factors, the authors note that a distinction should be made between the theoretical track capacity and the practical track capacity. The theoretical capacity is the maximum number of paths available in a day. The practical capacity measurement acknowledges that high line usage will leave little spare capacity before a late-running train causes significant delays to other trains—a 'domino' effect. Consequently, train services become very unreliable. Thus, the practical capacity is the number

103 In some cases, extra loop capacity will be required to enable faster ('premium') trains to overtake slower trains moving in the same direction.

of trains that can be handled in a day without delays exceeding a defined level (BTCE 1995, pp. 12–15). In the subsequent discussion we do not distinguish between these two measures though the principle remains.

Frequency of passing loops

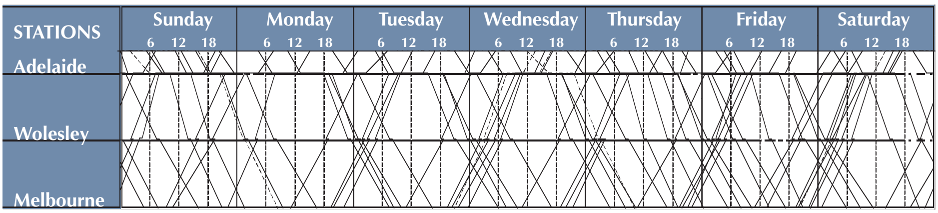
The frequency of passing loops is an important determinant of single track line capacity. The loop frequency can be measured in distance or travel time between loops. Travel time is a more relevant determinant of line capacity. For instance, on the Adelaide–Wolseley line, the distance between the Adelaide (Mile End) terminal and the next 1 500 metre loop at Belair is about 18 km whereas the comparable distance between the Wirrega loop and Wolseley is 34 km. However, the steep and windy track alignment outside of Adelaide means that the journey time to Belair is around 30 minutes, compared to 29 minutes between Wirrega loop and Wolseley.

Although loop frequency is important in determining track capacity, it does not necessarily follow that there would be any value in setting standard (equal) time frequencies between loops, because utilisation of train paths is not evenly distributed across the day. Train departures from a city tend to be clustered, reflecting freight market patterns—when the goods are delivered to the rail terminal, when the goods are required at the destination or both. Thus, as illustrated in the train path usage diagram below (Figure 3.7), path usage is clustered around late afternoon departures from Melbourne.[104] With similar (though less marked) clustering of Perth/Adelaide-to-Melbourne services, trains tend to meet in clusters. As Figure 3.7 shows, the clusters in this case tend to meet in western Victoria. Thus, the usage of passing loops or lengths of double-track (and, therefore, their value in contributing to track capacity) is maximised in specific physical locations. This business case may be reinforced if relatively little engineering work is required at these points.

In general we can conclude that the optimal frequency of passing loops will depend on factors such as the demand for the additional capacity at specific locations and the relative supply cost of installing loops at different locations.

104 This is an illustration of a conventional train path planning diagram. The numbers under the days of the week represent the time of day (with a 24-hour clock). Using the time and the station list on the left side, it is possible to chart the timetable of different trains, represented by the diagonal lines.

3.7 Profile of train path usage, Melbourne–Adelaide line



Source: ARTC web site <http://www.artc.com.au/docs/accessSeeker/pdf/access_2.4/ARTC_CUSTOMER_COMMITMENT_CHART.pdf>

Journey time between passing loops

The journey time between passing loops on single track can be an important parameter in determining track capacity. Maunsell have reported the results of a Canadian study into single-track capacity. Maunsell note that the study found that the effective useable capacity of a single-tracked line was estimated to be about 60 percent of the maximum number of trains that could move between the two passing loops on the route that take the longest journey time to traverse (Maunsell 2001, p. 24). So, for instance, if the longest time interval is 30 minutes, then in a 24-hour period, the effective capacity would be 60 percent of 48 trains, or 28 trains.[105] Note, however, that the 60 percent estimate reflects actual on-the-track time schedules, where trains follow or cross each other and where train speeds differ. (However, if moving-block signalling[106] is adopted, the number of trains that can operate on the track is increased significantly; the actually number of possible trains would (like the estimated 60% figure) be a function of actual train movement patterns.)

The principle here of inter-loop journey time defining the effective track capacity is correct. However, that calculation must be route-specific. That is, the calculation depends on the actual *pattern* of train path usage. Thus, for instance, the train path usage illustrated

105 That is, 24 hours times 1/2 hour = 48 trains. Then 48 trains times 60% equals 28.8 trains.

106 In conventional signalling, the minimum space between two trains is the distance between two signals. This train spacing is usually much greater than with moving block signalling, where the spacing between trains is determined by a distance envelope around the train.

in Figure 3.7 shows that capacity is more likely to be constrained by the 'bottleneck' of the cluster of trains passing in western Victoria than by lengthy inter-loop journey times *elsewhere* on the route. At its extreme, a long inter-loop time is irrelevant to capacity constraints if that loop is not used.

It should be added that where capacity constraints occur, it may be more cost-effective to have differential track access charges, which encourage use of train paths outside of periods of high demand, rather than invest in additional capacity.

Do variations in track capacities impede train operating efficiencies?

There are varying standards for track capacity across the Australian network, which is predominantly single-track. The time between/frequency of passing loops on single track is then one important parameter in track capacity. The maximum unrestricted train length permitted on the corridor is important for track capacity in that it influences the number of trains that are then operated and therefore impacts on the available track capacity. As shown in Figure 3.8, the track capacity has been increased in recent years by constructing longer passing loops; this has given trains almost 30 percent more capacity (length) between Port Augusta and Kalgoorlie and around two-thirds greater capacity on the Melbourne–Adelaide section.

However, there is no specific standard that should be adopted for track capacity per se. The demand for train paths is not evenly spread over the day or even over the week (or year). As a consequence there are varying demands for track capacity and the level of optimal capacity varies across the network and along specific parts of each individual line. Thus, optimal track capacity is necessarily customised to specific demands rather than standardised to a consistent level.[107]

In recent years, the traditional non-bulk freight has dwindled but the interstate, intermodal task has grown substantially. To capture economies of density on these interstate routes, the 'standard' has evolved and longer, infrequent trains are preferred to shorter, more frequent services. As a consequence, the nature of the track capacity

107 Pudney and Wardrop (2004) describe a computer-based capacity allocation system that recognises that the optimisation of capacity utilisation in Australia requires balancing between a range of parameters, not least of which is the desired train departure and arrival times.

has led to long passing loops and away from the traditional, more frequent, short loops. Investments since the mid-1990s have moved the interstate system towards this standard. That is, the standard is emerging to meet the train operator needs.

Maximum train length

Maximum train lengths permitted on a line are determined by the length of the passing loop and the gradient. Lengthening passing loops increases track capacity in two ways. First, for any given level of freight movements, more freight is moved with fewer trains. Secondly, increasing the length of loops enables longer trains to operate.

For instance, the current specification of the Adelaide–Melbourne route enables regular operation of 1 500 metre long trains, as illustrated in Figure 3.8. Some of the loops on the line are shorter than 1 500 metres. However, this is a capacity constraint only if the trains cross at a shorter loop or *both* trains are longer than the length of the passing loop. Thus, of the 15 passing loops between Adelaide (Mile End) and Wolseley (for the South Australian/Victorian border), eight of those loops are less than 1 500 metres in length.[108] If the infrastructure manager seeks to schedule additional trains, inadequate loop lengths could become a defining constraint to line capacity. At this time, around five trains pass each way per day. Typically, this means that a train is likely to cross between one and three trains at a loop between Adelaide and Wolseley—with some trains being overtaken (as illustrated in Figure 3.7).

As noted earlier, there can be limits on train capacity because of trailing load restrictions. Conversely, track capacity is constrained due to steep line gradients/curvatures. Thus operators then have to schedule multiple, short trains rather than infrequent, long trains. The consequence is that effective track capacity is constrained.

Terminal capacity

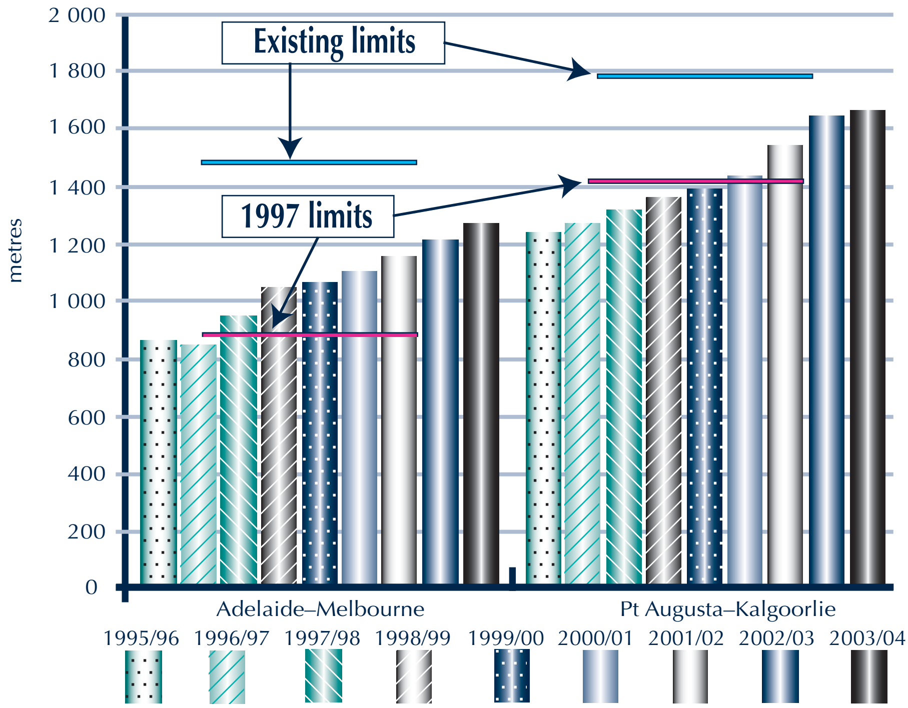
Whether a railway terminal conforms to standards in capacity specification and handling capabilities is an important aspect of overall railway operation. Consequently, how the terminal operates is crucial to overall railway efficiency. It represents perhaps one-third—or more, if the journey length is short—of the total terminal gate to terminal gate costs.

108 See ARTC 2003, Appendix II, p. 6.

3.8 **Trends in lengths of passing loop and capacity utilisation**

TRAIN LENGTH BY CORRIDOR

Average for High Flagfall Services



Source: ARTC 2004b.

Thus, compatibility of equipment and capacity is essential. At one end of a railway corridor, the terminal design and capacity may be compatible with a given train operation, such as intermodal, infrequent, long-trains). But is the terminal at the other end of the corridor equally compatible?[109] As a United States study has noted:

> The rate at which traffic can be passed along a network link is of little or no consequence if terminal facilities at the end of that link cannot

109 As a simple example, BTCE (1997, p. 44) found that at Dynon terminal, trucks carrying top-lift containers (such as ISO containers) could be lifted between rail wagons and trucks in about 1 minute, compared with about five minutes for a bottom-lift unit. However, at Kewdale the handling times for the two transfer types were similar; this was explained by the relatively fewer bottom-lift machines at Dynon (Ibid., p. 84) than at Kewdale (Ibid., p. 86).

> receive the movement and dispatch it onto the next leg of its journey. Thus, terminal facilities are of paramount importance in determining a route's capacity. (Tennessee Valley Authority & Center for Business and Economic Research, p. 13)

Similarly, the United States' Inter-State Commission (1987, p. 73) notes that 'Efficient terminals require paved areas and lengths of track appropriate for the volume of traffic and the equipment being operated'. When the commission wrote its report, it also noted that this can lead to restrictions on the train lengths that can be operated (Ibid., p. 141).

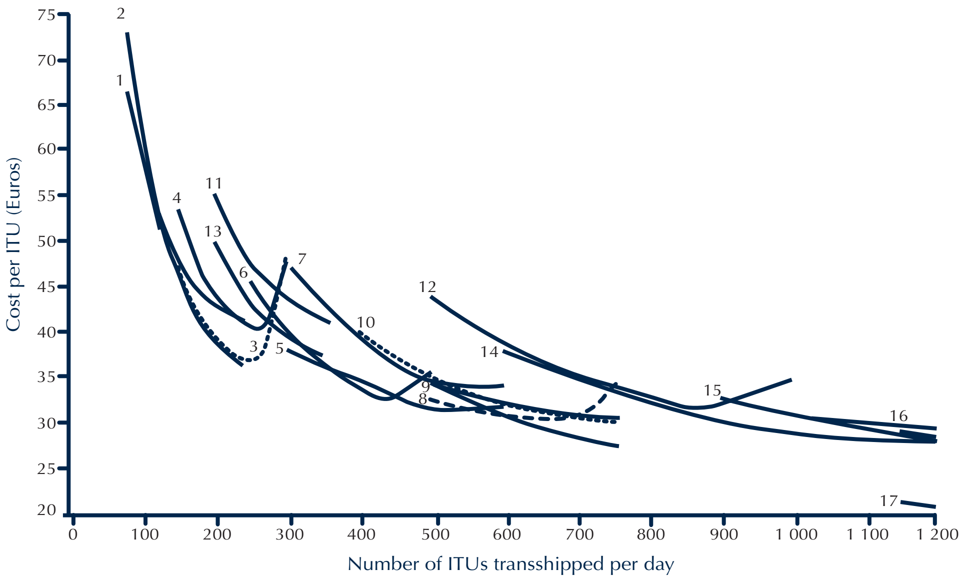
Terminal parameters will include the:

- length of handling tracks;
- number of operational and storage tracks;
- number of trains being assembled—and, as a related issue, the extent of third-party or open access at the terminal;
- handling equipment used to transfer containers across vehicles; and
- handling of road freight vehicles to deliver and pick-up containers.

When a given terminal handling parameter reaches its limit, it impacts on train operating efficiency. That is, it affects train length, loading and unloading and marshalling time.

In Figure 3.9, the per-unit costs of various terminal designs are illustrated. It is clear that, for a given terminal throughput, the per-unit cost can vary widely, depending on the terminal design and, thus, equipment chosen. A related point is that, for a given terminal design, as the throughput increases, the unit handling costs often stop declining and can begin to increase. In Figure 3.10, we present an illustration of non-bulk freight-container-terminal capacity. Brennan (2001) identifies the rail terminal capacity parameters being a function of factors such as track length, wagon fleet mix, wagon dwell time for loading and unloading, traffic imbalances, train schedules and storage track capacity (Brennan 2001). For example, Queensland Rail's Brisbane–Melbourne train needs to be split on arrival at the Melbourne (Altona) terminal to be accommodated within the relatively small terminal (Linfox 2004, p. 3). In the example shown, it is the terminal equipment that is the effective capacity bottleneck.

3.9 Comparative cost analysis for alternative terminal designs (including infrastructure, personnel and road vehicle times)



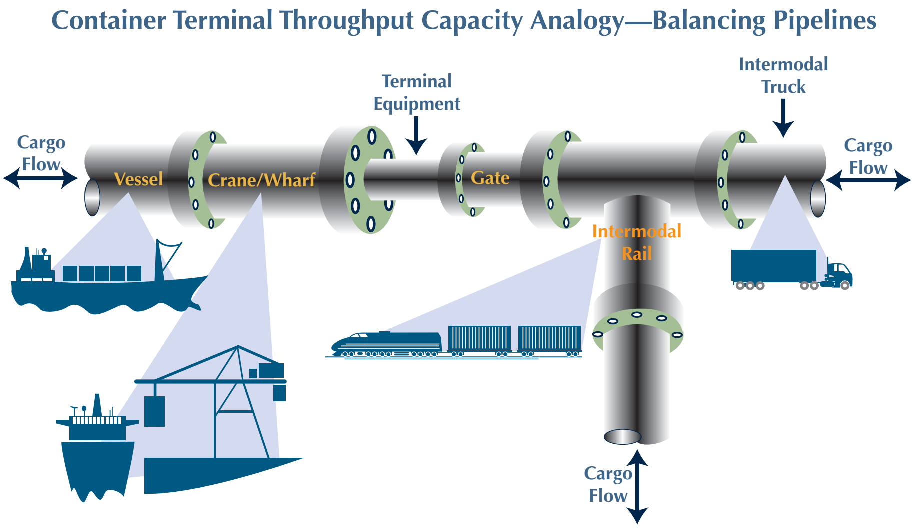
1. Half Module—2 Reach Stackers operating at 15 ITUs / h—truck pattern adjusted to train arrival
2. Full Module—2 Reach Stackers operating at 15 ITUs / h—truck pattern adjusted to train arrival (upper) and to ITU availability (lower)
3. Half Module—1 Gantry Crane operating at 22 ITUs / h—truck pattern adjusted to train arrival
4. Full Module—1 Gantry Crane operating at 22 ITUs / h—truck pattern adjusted to train arrival
5. Full Module—Moving train technique—1 crane—Single Area Variant—truck pattern adjusted to train arrival
6. Full Module— 2 Gantry Cranes operating at 24 ITUs / h—truck pattern adjusted to train arrival
7. Full Module—Moving train technique—1 crane—Basic Variant—truck pattern adjusted to ITU availability
8. Full Module— 3 Gantry Cranes operating at 24 ITUs / h—truck pattern adjusted to train arrival
9. Full Module— 3 Gantry Cranes operating at 28 ITUs / h—truck pattern adjusted to train arrival (upper) and ITU availability (lower)
10. Full Module—Moving train technique—2 cranes—Single Area Variant—adjusted to train arrival truck pattern
11. Two Full Modules X 2 Reach Stackers operating at 15 ITUs / h—truck pattern adjusted to train arrival
12. Two Full Modules X 2 Gantry Cranes operating at 24 ITUs / h—truck patternadjusted to train arrival
13. Half Module—2 Gantry Cranes operating at 24 ITUs / h—truck pattern adjusted to train arrival
14. Full Module—Moving train technique—2 cranes—Basic Variant—truck pattern adjusted to ITU availability
15. Two Full Modules X 3 Gantry Cranes operating at 24 ITUs / h—truck pattern adjusted to train arrival (upper) and to ITU availability (lower)
16. Unidirectional bridges design (the design requires new wagon types and special ITU corner casting attachments)
17. Bi-directional rolling gantry crane (the design requires new wagon types and special ITU corner casting attachments)

Note: ITU stands for ‘Intermodal Transport Units’.

Source: Ballis and Golias, (2002, p. 609).

Terminal rail capacity issues are even more complex when they involve handling interrelated sea port terminal freight movements. The primary capacity usage parameters are the traffic imbalances and the balance of traffic between container and other movements. In particular, how easily the goods can be loaded and unloaded between road/rail/sea modes will affect the terminal efficiency. Also, the frequency of train departures—whether the traffic is being shifted by rail in large or small consignments—will affect the operation.

3.10 Terminal capacity parameters



Source: Brennan (2001).

Thus, we can conclude that efficient terminal capacity must be customised to meet traffic patterns and levels. Failure to do this, or over-standardise, could reduce railway efficiency.

Does diversity in terminal parameters matter?

The 'optimal' terminal capacity, design and location is very subjective. For instance, O'Donnell (2005), the Chief Executive Officer of Pacific National, noted the dilemma rather than prescribing a solution in terminal provision in Sydney—whether there should be multiple terminals around the urban area or whether there should be a single, large terminal. Without advocating the ideal terminal form, he noted the difficulty in finding land in cities that enables sufficient terminal capacity to accommodate freight trains of 1.8 kilometres long.

In its review of rail terminals, the Bureau of Transport and Communication Economics (1995, p. 66) noted that the Adelaide (Islington) terminal had track lengths of 1 200 metres whereas trains of 1 800 metres were arriving or leaving the terminal. However, the bureau noted that the deficiency was 'overcome by operating procedures at relatively little cost'. That is, in this situation, the bridging costs were assessed as not being significant.

In this context, we can identify that optimal terminal capacity is highly relevant to efficient railway operation. This is likely to require a customised specification rather than conformity to a common standard. While the increasing train length suggests a need for larger terminal sites, other terminal specifications will be a function of the level and type of traffic moved.

Safeworking

The legacy of State jurisdiction-owned, intrastate railways with independent operating cultures strongly influences how the national network operates today. Booz Allen Hamilton has reported the perception that the differences in safeworking systems, telecommunications frequencies, axle loads and train speeds arose from 'fragmented safety regulation'. However, as Booz Allen Hamilton note, this is not the case: 'As important as [these factors] may be, they are not safety regulation matters' (BAH 1999, p. IV-4).

There is diversity in the form of safeworking systems on the intercity main line network and the secondary and branch lines. The systems that are adopted arise from a combination of customisation, or fit-for-purpose, individual management decisions of State-based organisations and historical legacies. In the past, the full consequence of this diversity for train operations was not readily apparent. This was because locomotives, track management, train crewing and management were managed within State borders. Note that even within State systems on individual corridors, there are multiple safeworking systems. The increasing practice of through-running of trains and crews across borders, and the unitary management of most of the interstate network, has exposed where there may be excessive diversity.

In the following sections signalling is considered independently of communications. We note, however, that the historical boundary between them in the overall safeworking system is increasingly blurred.

Safeworking systems

In this section we consider the degree of diversity in safeworking systems—both procedures and technologies—and the consequences for bridging costs.

While there is a range of different safeworking systems, they can be described as having two principal features: the position of trains and conveying instructions to drivers. There are varied systems for establishing the position of trains. Global Positioning Systems and track circuits accurately locate trains while axle counters and radio communication provide less precision. Instructions are conveyed to drivers by verbal communication or in-cab communication systems, or by line-side signals.

In Figure 3.11, we illustrate how these features link together. The figure is necessarily simplified—the permutations and combinations of safeworking systems are, in practice, more diverse. It is also important to note that different parts of the rail network may have common technologies—such as electric staff, or token, systems.[110] However, the working rules that lie behind those systems may differ across the systems. In any case, even with common safeworking systems, the systems specifications may differ due to the different age of the system and different manufacturers.

In the next section we discuss the degree of standardisation in safeworking in Australian railways—how drivers receive instructions and how train controllers identify train location.

Receiving instruction

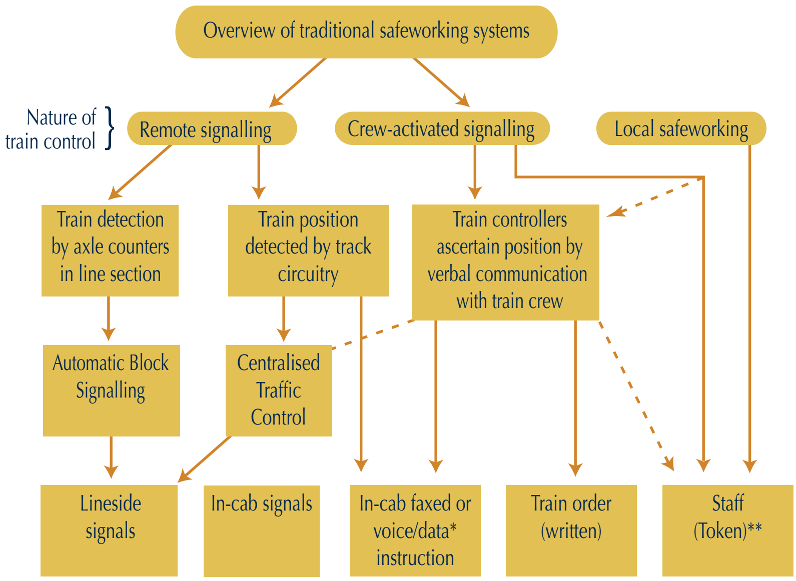
There are two issues that are relevant to how drivers receive instructions:

- types of safeworking systems; and
- interpretations of signalling systems.

There are several variants of safeworking systems. For instance, there are different ways of instructing the driver as to whether the train can proceed. There are also different operating buffers or physical envelopes around which the trains are spaced.

110 See glossary for a definition.

3.11 Traditional safeworking systems



* Known as Alternative Safe Working **Multiple, interlocked tokens or single (staff and ticket) token

Australian infrastructure uses three key ways to instruct drivers:

- **Visual signalling.** The driver observes indicators visually. This takes the form of line-side signals.[111]
- **Verbal or written instruction, or 'communications-based' systems.** The driver may be advised of line clearance in real time by verbal or faxed/computerised instruction (train order) or in advance by written instruction.
- **Staff (token) mechanisms.** The driver may be advised of line clearance through a mechanical interlocking device, such as a staff, or token. This may involve a train crew member alighting from the locomotive to collect or exchange the staff—see Figure 3.12.

The spacing between trains—that is, simplistically, the line capacity—is usually a function of the technology chosen. As the system becomes more sophisticated, greater information flows enable trains to operate closer to each other.

111 There are proposals for the introduction of in-cab signalling.

3.12 Mechanism for staff (token) system

Source: Mark Carter, GRMS*MEDIA*.

These forms of safeworking have been implemented across the intercity network in different forms. Within a single safeworking system, however, there can be variations in the way that the driver responds. In 1998, for instance, National Rail reported an instance of a line section using electric staffs, that had four changes of signalling system:

> First, drivers must respond to double colour light signals for several kilometres, then single colour light signals, then back to double, then to upper quadrant semaphore signals (wig-wags), and then lower quadrant semaphore signals, and finally for the remainder of the sector, single aspect colour signals. (National Rail 1998a, p. 24)

The interstate network has a range of signalling systems—see Table 3.6.

3.6 Safeworking systems on primary interstate network

Location	*Line segment*	*Safeworking system*	*Trackage*
WA	Kwinana-Avon Valley	Centralised Traffic Control	Double track, dual gauge
	Avon Valley-Northam	Centralised Traffic Control	Single track, dual gauge
	Northiam-Koolyanobbing	Centralised Traffic Control	Single track
	Koolyanobbing-Kalgoorlie	Centralised Traffic Control	Single track
WA/SA	Kalgoorlie (WA)-Coonamia (SA)	In-cab Train Order [a]	Single track
SA	Coonamia-Crystal Brook	Centralised Traffic Control	Double track
	Crystal Brook-Dry Creek	Centralised Traffic Control	Single track
	Dry Creek-Mile End	Centralised Traffic Control	Single track
SA/Victoria	Mile End-Maroona	Centralised Traffic Control	Single track
Victoria	Maroona-Gheringhap	Section Authority Working [b]	Single track
	Gheringhap-Newport	Centralised Traffic Control	Single track
	Newport-Tottenham 'B'	Centralised Traffic Control	Single track
	Dynon-Appleton Dock	Access Authority Working	Single track
	Bunbury St Tunnel- West Footscray Junction	Centralised Traffic Control	Double track
	Footscray Junction-Albury	Centralised Traffic Control	Single track
NSW	Albury-Junee South	Centralised Traffic Control	Single track
	Junee South-Wallendbeen	Automatic Block Signalling	Double track
	Wallendbeen-Harden	Block Telegraph	Double track
	Harden-Medway Junction	Automatic Block Signalling	Double track
	Medway Junction-Exeter	Block Telegraph	Double track
	Exeter-Campbelltown	Automatic Block Signalling	Double track
	Hornsby-Broadmeadow	Automatic Block Signalling	Double track
	Broadmeadows-Casino	Centralised Traffic Control	Single track
	Casino-Greenbank	Electric Staff	Single track
Queensland	Greenbank-Acacia Ridge	Automatic Block Signalling	Single track
SA/NSW	Crystal Brook-Broken Hill	Automatic Block Signalling	Single track
NSW	Broken Hill-Parkes	In-cab Train Order	Single track
	Parkes-Stockinbingal	Electric Staff	Single track
	Stockinbingal-Cootamundra	Electric Staff	Single track

a Verbal train order system.
b Also known as Section Authority System; and Alternative Safe Working, ASW.

Source: ARTC (2000); ARTC (2003, p. 15); Rail Infrastructure Corporation 2003, *Train Operating Conditions Manual*, passim.; communication with ARG.

The table illustrates the diversity of systems used on the interstate system. The Albury–Sydney section illustrates, however, where some diversity may optimise the infrastructure in place. For instance, the Albury–Junee South section is single track—a low-capacity provision which is offset to an extent by the use of Centralised Traffic Control safeworking. Immediately north from Junee, Automatic Block Signalling is used. While, in principle, such signalling results in lower track capacity, the route has double-track, which provides additional capacity.

In this context, the signalling diversity can provide a suitable safeworking environment—particularly as they can complement other areas of technical diversity, in this case, for instance, single—versus double-track. However, this does not mean that the extent of this diversity is desirable. But a low return on investment may preclude reducing this range in the immediate future. In this context, we should not see the diversity as necessarily reflecting desirable customisation. For instance, interspersed in the Automatic Block Signalling safeworking system between Junee and Campbelltown, are two sections of block telegraph safeworking. This system (using semaphore signals) is illustrated in Figure 3.13. This system is in place for *historical* investment reasons rather than because it is the most appropriate technology.

The second signalling issue is that, even within a classification of signalling, there can be a different *interpretation* of what the signalling is telling the driver. Even the naming of the types of signals varies across infrastructure managers and States. For example, a railway signal showing a green light set above a second, red, light means something different to the driver depending on whether they are in NSW or Victoria. The differing interpretations appear to have resulted from the independent management of the different State-based railways. Historically, train drivers did not normally operate outside their home State.

As with other areas of diversity—such as goods moving over different rail gauges—the consequences of this difference in interpretation depend on the context. For example, the extent to which, in the course of their work, an individual train driver has to interpret the

3.13 Block telegraph safeworking, Bundanoon, NSW, on the Sydney–Melbourne line

Source: Mark Carter, GRMS*MEDIA*.

instructions given by the signal in different ways depends on where the driver is. The need for drivers to interpret a range of different signals occurs more than previously. As noted earlier, train operators, and their crews, routinely operate their trains across jurisdictions. The diverse interpretations lead to a need for additional driver training and heightened vigilance.

Identifying train location

The second key aspect of safeworking is the train location system. In authorising a train to proceed, the signaller or automatic signalling system needs to know the position of other trains. Increasingly, radio-communications and satellite, or Global Positioning System, are used to ascertain the exact location of trains. There are several main systems used:

Axle counters

These are a simple system for remote train control and involve the 'rail vehicle detection' system—notably, by axle counting. The number of train axles on a section of track is measured by a track circuit. The train is assessed to have cleared a given section of track when the number of axles that has entered that section is equal to the number of axles that has left that section. The detection of axles entering and leaving the section may then be interlocked with visual signals. This enables other trains to move once the circuitry has concluded that the section of track is clear.

Track circuitry

This is a more advanced derivation of axle counting but has notable differences. Axle counting can locate the position of the train only down to the protected section of track. Thus, a train controller may know only that the train is somewhere within, say, a 20 or 50 kilometre section of track. By contrast, with track circuitry, the signaller at a remote location can pinpoint the train's exact location. Use of track circuitry is a key feature of Centralised Traffic Control, where trains are interactively controlled from a remote location.

Train order

This system does not pinpoint the train location. The train is given exclusive use of a given location or track section, by an authority to proceed—written and possibly faxed, or voice-transmitted.

Staff (token)

As with train orders, these forms of authority to proceed do not in themselves pinpoint the train's position. The train is given exclusive use of a given location, or track section, by an interlocking electric staff.

Do multiple safeworking systems impede train operations?

Diversity in safeworking can enable fit-for-purpose solutions to a railway system that faces diverse supply costs and traffic demands. For instance, train frequencies, complex routeings, speeds and stopping patterns of urban passenger systems require a more complex safeworking system. Such systems must deliver a high-capacity system without compromising safety. At the other end of the scale, there are country branch lines. Often, they have only a single train occupying the track at any one time so a simple safeworking system will deliver a cost-effective, but still safe, solution.

To the extent that there are concerns with safeworking diversity, they relate to the issue of drivers receiving instructions rather than to the diversity in train-locating devices. The diversity of safeworking may not, however, be optimal—there may be too many systems. In 1998, Maunsell reported rail industry platers' adverse comments about the number of safeworking systems. They told Maunsell that:

- excessive diversity increases costs and reduces flexibility of driver management;
- they are concerned that the different safeworking systems and related multiple procedures and rules make it difficult for drivers to 'remain conversant', paraphrasing Westrail's concerns, (Maunsell 1998, p. 13), and highlighted consequent safety implications—especially in the context of incidents leading to accidents due to confused responses; and
- differing signal spacing may prevent the development of common standards for train lengths.[112]

However, it is also the case that even within a given signalling system, the form of instruction—such as the nature of the line-side signals—can vary. This was demonstrated in the example quoted by National Rail and discussed in Chapter 2. This has training and safety consequences. More training and vigilance is needed to achieve a given safety level. Excessive diversity can often be resolved only by investment.

Some proposed investment will reduce this diversity. Through its single management of most of the interstate system, the ARTC is proposing to introduce an Advanced Train Management System. In addition to its anticipated efficiency benefits and capacity enhancements, the system would replace multiple safe-working systems (ARTC 2004c, p. 22).

112 On this, Maunsell note, however, that signal spacing results from the investment decision legacies and cannot be altered in the short-term.

Communications systems

Communications are an important component in the safeworking of trains across the network. The different functions of communications lend themselves to the development of multiple systems. For instance, there is a need for communications for:

- one-to-one contact between the driver and the train controller on the main line;
- contact between the driver and other crew or the train controller for local shunting movements and at stations;
- group working contact between a train crew and crews on other trains;
- emergency broadcasts; and
- passenger information—see, for example, BAH 2003, p. 55.

With these diverse functional needs and with the legacy of independent jurisdiction-based investment decisions, it is not surprising that the communications systems differ significantly across the network. Deveney reports that the:

> ...communications facilities and current call types have evolved due to the different safeworking practices of the rail authorities and their investment strategies. Each system has evolved to best meet the requirements of their operation and necessarily are influenced by the equipment capabilities which in turn depend on the level of investment. The differences between systems is a major inhibition to flexible locomotive operation on the interstate corridors. (Deveney, reported in National Rail 1998a, pp. 24–25)

The increase in flows of locomotives, rolling stock and crews across the traditional operational boundaries has increased focus on communications, and signalling, differences. At the same time, technological changes have led to the communication systems increasingly becoming the central mechanism for safeworking systems. This has increased their importance.[113] A range of on-board

113 In particular, historically, main line safeworking could be operated by the train driver taking visual instruction from the position of lineside signals. Increasingly, instruction is occurring through written or spoken communications systems (that is, electronically-written or spoken).

and line-side communications equipment are used for dialogue between rail firms—operating on or near the track—and between the firms and, principally, the infrastructure manager. It includes telephones, radios, facsimile and computer equipment. Communications technology and operations are increasingly being combined with signalling equipment. And, with signalling equipment, differing geographical locations, historical legacies, operational requirements, traffic intensities and management ideas and practices have led to the adoption of multiple communications systems.

Consequently, there is a need for multiple forms of equipment, operating rules and training and adherence to the different systems. In 1998 National Rail reported that:

> Radio frequencies change frequently across the national track network, requiring complex radio equipment, and constant attention from drivers to ensure correct radio channels are selected for each task and area. The very large number of frequencies in use also places large demands on rail operators and track owners for provision of radio equipment and on controllers for attention to detail in its use (National Rail 1998a, p. 24).

To deal with the multiple radio systems, Pacific National has installed a communications-scanning system, AWARE. It is a form of bridging technology that is intended to be able to send and receive communications from all radio systems on the interstate system. As a related issue, in Queensland, new radio equipment has built-in global positioning system receivers that switch radios to the appropriate UHF channel (Booz Allen Hamilton 2003, p. 62); QR Network Access recommends automatic channel selection by use of a global positioning system. (QR Network Access 2002, p. 23)

Table 3.7 presents a picture of the different radio bands and systems used on each part of the intercity network. Although much of the system is UHF, there are important differences. For instance, Aitken notes that the 'trunk' UHF radio used in the Perth metropolitan area cannot be used elsewhere:

> [The system] is a trunked radio with narrow band operation. In general, radio transceivers that can provide the trunked radio operation cannot also provide the wide band conventional operation required

3.7 Communications system on network[a]

Location	Line segment	Communications system: Primary	Secondary system
WA	Fremantle/Kwinana-Midland	UHF radio (trunk)	Mobile phone
	Midland-Kalgoorlie (Parkeston)	UHF radio	Mobile phone
WA/SA	Kalgoorlie-Tarcoola	UHF radio (Channel 2)	UHF radio (Channel 5)
SA	Tarcoola-Port Augusta	UHF radio (Channel 5)	
	Port Augusta-Crystal Brook	UHF radio (Channel 2)	
	Crystal Brook-Dry Creek	UHF radio (Channel 2)	
	Dry Creek-Tailem Bend	UHF radio (Channel 5)	
	Tailem Bend-Wolseley	Mobile phone	
Victoria	Wolseley-Gheringhap	UHF radio (Channel 2) with Motorola ASW	UHF radio (Channel 6)
	Gheringhap-South Dynon	UHF radio (Channel 11) with Motorola ASW	UHF radio (Channel 2)
	Tottenham-Melbourne Spencer St	UHF radio (Channel 11)	Mobile phone, data, voice
	Tottenham-Albury (standard gauge)	UHF radio (Channel 6) with MDC600	Mobile phone, data, voice
NSW	Albury-Macarthur	UHF radio b (CountryNet c)	Satellite (CountryNet)
	Macarthur-Chullora	UHF radio b (MetroNet)	
	Chullora-Maitland	UHF terrestrial radio c (MetroNet)	
	Maitland-QLD border	UHF radio (CountryNet)	CountryNet
Queensland	QLD border-Acacia Ridge	Queensland Train Control Radio	Mobile phone, data, voice
	Acacia Ridge-Fisherman Islands	UHF radio (Channel 117)	UHF radio (Channel 72)
SA/NSW	Crystal Brook-Broken Hill	UHF radio (Channel 4)	VHF radio
NSW	Broken Hill-Parkes	UHF radio (CountryNet)	Satellite (CountryNet)
	Parkes-Cootamundra	UHF radio (CountryNet)	Satellite (CountryNet)

a Maunsell (1998, p. 26) notes that UHF channel frequency assignments are not consistent across States, for instance, the frequency for Channel 1 in one State does not necessarily have the same frequency in another State.

b Justice McInerney, in his report into the Glenbrook rail accident in 1999, noted that the NSW country radio system (CountryNet) and the Sydney urban radio system (MetroNet) were incompatible (McInerney, p. 139).

c According to the Rail Safety Act 2002 (p. 20), the CountryNet region extends beyond the electrified lines in Sydney, that is, beyond Lithgow in the west, Macarthur in the south and Maitland in the north.

Source: Aitken (2002).

> for the rest of the country. (At least one manufacturer provides a "dual mode" radio but this radio is suitable for neither Countrynet nor Metronet). (Aitken 2002, p. 428)

Aitken also notes that UHF radio can only be used in Victoria when it is connected to a Motorola ASW or Motorola MDC600 unit. The MDC600 is no longer being manufactured. For NSW's Metronet and Countrynet a 'special duplex' radio is required. The radio must be capable of continuous transmission—a performance that Aitken believes few mobile radios are capable of achieving. (Aitken 2002, p. 428)

The two primary systems in NSW are not just different from systems in other States—they are also not compatible with each other. Justice McInerney's inquiry into the late-1999 Glenbrook rail accident noted: 'The Metronet and Countrynet systems are not compatible with each other' (McInerney 2001, p. 138). There appears to have been no rationale for building in this inconsistency and the development of a patch to enable the two systems to talk to each other has proven difficult (pp. 139–140). Justice McInerney commented and concluded that:

> For reasons which were not explained to me, when the Metronet system and the Countrynet system were introduced [at around the same time period], the incompatibility was known yet the system was introduced notwithstanding that obvious limitation and the consequence to safety involved in having incompatible radio systems which meant trains not equipped with Metronet radios were forced by the safeworking units to use antiquated technology. (McInerney 2001, p. 140)[114]

Other inconsistencies are apparent, such as whether or not train-to-train communications can be undertaken or whether radio channels are open—that is, can be heard by third-parties. For example, open communications and train-to-train communications are undertaken in Queensland but not in NSW (McInerney, p. 143).

We can acknowledge the problems that can arise from having the multiple, but incompatible, radio systems in Australia. In this case, optimality does not mean having one radio system. For example, the EU standard radio system is GSM-R. This system is suitable for the urban environment where the more frequent services justify the high investment costs. However, it is inappropriate in remote areas where 'it makes no sense to have something next to the track every 15 km in the desert'—according to its Deutsche Bahn Netz advocates. (Taylor 2004)

That said, it is critical that each system have an operational interface: '…there must be a link with the GSM-R technology with

114 On the evidence given to him by the project manager for the Metronet project, Justice McInerney concluded that the 'Metronet system could have been implemented for the whole of New South Wales, thereby avoiding the incompatibility that has existed between the Metronet system and the Countrynet system'. (McInerney 2001, p. 140)

whatever alternative system is to be used for such isolated operations'. (Taylor 2004)

Is it 'efficient' to have multiple communication systems?

It is inevitable that where there is interface between communications systems, there will be:

- a need for additional crew training;
- additional equipment to enable locomotives to be operated across different communications systems; and
- the potential for safety standards to be lower than would otherwise be expected.

Thus, communications diversity is one area where the bridging costs across the systems are very evident. Booz Allen Hamilton reports that Pacific National has a database of national radio frequencies and costs in excess of $50 000 are incurred each time a track manager changes a frequency or channel (Booz Allen Hamilton 2003, p10). The company noted that:

> The lack of common communication platforms is particularly felt in the interstate rail freight market. Operators have found it necessary to procure and maintain multiple communications equipment, maintain detailed radio frequency data and educate staff in multiple operating environments. (Booz Allen Hamilton 2003, p. 4)

The safety implications that arise from the additional communications interfaces were illustrated in the New South Wales railway accident at Glenbrook. Justice McInerney, found that the use of incompatible communications systems caused delays that compounded the errors that led to the accident, thereby increasing the likelihood of the accident occurring:

> The combination of the two incompatible methods of communication meant that the headway, or time between the two trains [that subsequently collided], was necessarily reduced. (McInerney 2001, p. 11)[115]

115 Justice McInerney, noting that the two main line radio systems (MetroNet and CountryNet) were incompatible, observed that the consequence of this was that '...trains not equipped with Metronet radios were forced by the safeworking units to use antiquated technology'. (McInerney 2001, p. 140)

The judge then recommended that a single national communications system be adopted (McInerney 2001., p. 141). He repeated this recommendation after completing his inquiry into the 2003 accident near Waterfall, south of Sydney (McInerney 2005).

As noted earlier, there are necessary functional differences in communication systems. For example, in some circumstances, such as communicating when undertaking local shunting, a local system might be appropriate. However, this local system might be accommodated within an open radio channel and systems that incorporate links such as train-to-train, that is, through protocols.

The bureau understands that some of this diversity arises through different decision-making in different jurisdictions. it also occurs with different communications solutions for different geographical and traffic level conditions. However, it is unclear why State jurisdictions installed incompatible systems without the protocols to enable interoperability. A clear example of this was the installation of the MetroNet and CountryNet systems *within* NSW's State Rail Authority. These two communications systems were installed at around the same time but were incompatible with each other. The communications interface is also different. MetroNet enables train crews to talk with signallers and CountryNet enables train crews to talk with train control (Fellows Medlock 2003, p. 26).[116]

There can be large bridging costs for Australian railway operators in having diverse communications systems. However, some diversity is optimal. The urban-passenger and non-urban freight have vastly differing safety risk factors and very different communications (functional) needs. There are high sunk costs in the current communications infrastructure so any convergence to fewer systems would appear to have to be protracted. Indeed, Booz Allen Hamilton noted that this results in a *Catch-22* in investment: 'Ultimately, [infrastructure managers] are obliged to invest in a communications

116 Quite apart from the incompatibility issue (which could have been addressed by appropriate bridging interfaces), Justice McInerney argued that the MetroNet [land-based] radio system could have been applied to the entire NSW system without the need for the separate [satellite and land-based] CountryNet radio system. Since the McInerney Report, RailCorp/RIC has undertaken to address the interface issue between the two systems. (Booz Allen Hamilton 2003, p. 63)

system that best suits their local environment, perpetuating the disparities amongst railways'. (Booz Allen Hamilton 2003, p. 34)

There is the opportunity for some diversity to be accommodated, however. In Chapter 2 we considered the principle of standards, compatibility and protocols. Booz Allen Hamilton suggests that protocols in communications would be the minimum position for any future systems. In particular, they advocate the use of protocol systems such as TCP/IP global communications protocols. These would enable diversity in requirements and functionality while providing for interoperability at the interfaces (Booz Allen Hamilton 2003, p. 4).

Will industry embrace a common protocol? In Chapter 2 we also addressed the issue of how optimal standardisation comes about and whether commercial pressures alone will bring that about. Historical decision-making at the local level, and relatively low flows of traffic across the jurisdictional boundaries, have bequeathed a communications system that is inappropriate for the growing national rail freight market. In 2003 Booz Allen Hamilton observed that there was '...no single decision body that represents the entire industry in matters relating to railway communications strategy'. They noted, however, that the ongoing development of Railways of Australia standards—in the form of ARA's Code of Practice—offers an opportunity to resolve the issues (Booz Allen Hamilton 2003, p. 34). Since then, we note that the ARA has strengthened its facilitating role in bringing together the industry players to collaborate on standard-*setting*. For instance, the ARA has been coordinating industry meetings to bring about the establishment of a single national communications standard for metropolitan railways. However, given the longevity of assets and budget constraints, the implementation of such standards will probably be protracted.

We have identified that an appropriate role for government in assisting the optimisation of standards is through facilitation. In this context, the Australian Government has facilitated and supported development of the Code of Practice, which is now managed by the ARA's Code

Management Company. The railway industry has long-lived assets and low financial returns and operates in an environment of rapid technological change in communications. In this case, the business case for overnight convergence to a common protocol is not strong despite the sometimes-high bridging costs arising from excessive diversity. There are safety (that is, public welfare) concerns with incompatible communications systems, as articulated by Justice McInerney in his Glenbrook and Waterfall accident inquiries. In his report on the Waterfall accident, McInerney called for a more interventionist government role. He stated that '…procedures and protocols should be standardised and mandated by regulations' (McInerney 2005, p. xxiii). Governments' response to this call needs to be tempered, first, because it is relatively less efficient in choosing optimal standardisation than industry; and, secondly, by industry's progress in agreeing common protocols.

Other technical parameters

The technical characteristic described here is regarded as a 'headline' technical parameter. However—and as illustrated in the various technical specifications set out in the ARA's Code of Practice—there are numerous other parameters where there is technical divergence. For example, Justice McInerney, in his 2004 Waterfall Interim Report, refers to a 1994 NSW study, which observed that 'Safety systems and equipment were not consistent technically on different trains' (McInerney 2004, p. 274).

Power sources

A presumption of standardisation is often that a common standard is always better than diversity—or, what we would call customisation. An example of intentional non-standardisation is in power sources for propulsion.

The electrification of urban passenger railways is an example where customisation has been chosen explicitly, despite its inconsistency with non-urban operations. Urban trains in Sydney, Brisbane, Melbourne and Perth are usually electrically-powered from overhead catenary. In addition, some coal lines in Queensland have been fitted with catenary, for propelling coal trains by electric locomotives. By contrast, most non-urban trains are operated by internal diesel motors. States' decision to electrify only selected urban and coal lines was not made on the presumption that all rail lines would ultimately be set to a common, electrified, network. Rather, the decision to electrify the urban lines was made to take advantage of the superior operating characteristics of overhead-powered vehicles when operating in urban areas where intensive, stop-start operations require rapid acceleration. That is, implicitly, the operational advantages of the power source are assumed to outweigh the restrictions on where the train sets can operate.

However there is diversity within the electric propulsion systems—see Whitlam (1992) for further details. All Australian electrified lines have power supplied through overhead catenary wire. However, electric railways in Melbourne and Sydney/Newcastle/Wollongong use 1.5 kV DC current. The newer electrified lines in Perth, and on QR, use the more modern 25 kV 50 Hz AC current—for a more detailed discussion, see also Industry Commission 1991, p. 337.

In all areas of diversity in technical specification, the impact of the diversity depends on the costs incurred. For electrified rail, that impact is determined by the extra cost of building a range of electric vehicles and the extent to which bridging costs arise in moving them across systems. In practice, passenger stock does not move across urban systems. This is partially because other variations of specification, such as with loading outlines, may make those transfers impractical.[117] Manufacturing cost benefits make it desirable to adopt

117 Efforts have been made to capture economies of scale in urban carriage construction. The prototype Australian Urban Passenger Train, built in 1974, was intended to provide such a standard vehicle. In more recent years, because some carriages built for Adelaide and Melbourne were built by the same manufacturer, a common carriage frame was adopted. However, it is unlikely that urban trains can be made to a universal design due to the adoption of radically different structural standards such as the Sydney double-deck trains (for higher train capacity).

a common approach. There is, however, an array of technical specifications that would need to be standardised before this would be practical.

Concluding comments

As discussed in Chapter 2, optimal harmonisation can involve a balancing between the benefits from standardisation with those from customisation. After reviewing a range of technical railway parameters, the authors concluded that the optimal degree of standardisation depends very much on the parameter concerned. In particular, at one end of the scale, railways should be built to a common rail gauge. At the other end of the scale, the track capacity should be tailored to meet the specific traffic needs and to reflect the geographically-induced variance in construction costs. Customisation is a preferred outcome where the benefits flowing from that specific choice of standard outweigh the bridging costs arising from the diversity.

In the case of railway gauge, these bridging costs are clearly too great. However, once the investment has occurred there is often no financial case—particularly due to low traffic levels/low potential benefits—for conversion to a common gauge. Even where greater standardisation is desirable, much of the Australian railway network operates with low traffic volumes and low financial returns. Consequently, unless the returns from a given investment are significant and the costs low, the investment will not be warranted. Adopting the strategy of changing the standard when an asset is renewed has merit in that the incremental costs of this change may be relatively small. However, because the assets are long-lived, the benefits from this strategy will be realised only when all non-standard assets are replaced. An example here is loading outline.

In some cases, notably in safeworking systems and in communications, the training and safety case for a high degree of consistency is very strong.

Where the network consists of multiple organisations, it is inevitable that local factors will bias outcomes towards local specifications rather than balance local and network considerations. These factors include differing budget constraints, individual management decisions and interpretations. When a network is under single management, optimisation is more likely than when there are multiple managers. Thus, we should acknowledge that the ARTC's geographical expansion to become manager of much of the interstate track makes it an important vehicle for ensuring optimal harmonisation. This advantage of single network management also facilitates regulatory optimisation. To the extent that the corporation's single management of most of the interstate network reduces the number of interfaces, it makes it easier to negotiate with regulators.

There are different levels of consistency and optimisation that may be best achieved through common protocols, or interfaces, rather than identically-specified equipment. Operational requirements and functionality are important factors creating a tension between choosing tailored specifications and generic, but costly, common specifications. Traffic intensity—notably urban passenger versus rural branch lines—contributes to determining operational requirements while functionality is determined, in part, by types of train operation. For example, shunting versus main line operations.

On this, the Community of European Railways expresses concern:

> ...about the impact on the competitive position of the rail industry from the regulations associated with technical harmonisation. It is clear that many of these investments would not be made by a commercial enterprise acting in its own self interest. (CER 2004, p. 3)

In Chapter 2 we considered the role of government in standard-setting and adoption. There are safety—that is, public welfare—consequences arising from what is arguably excessive diversity and/or insufficient interoperability in safeworking and communications. Government can facilitate industry to converge to a more optimal range of standards and to encourage interoperability through protocols. Generally, however, the diversity in traffic demand and operating environments make it difficult to establish a common standard. For this reason, the Community of European Railways' concern about regulating standards—that they will undermine rather than enhance the industry—have some justification.

Chapter 4

Regulatory harmonisation

Summary

Industry-specific safety, pricing and access regulation of Australian railways has been introduced in the last decade. The regulations have their roots in mandated track access. Each jurisdiction has established safety regulators and access regulators and at present there are about 200 safety-accredited (licensed) rail organisations. The safety regulations are based on ‘co-regulation’, which is neither entirely ‘self-regulated’ nor ‘prescribed regulation’.

Regulations need to be tailored to reflect variable conditions, such as ownership, industry structure, viability and/or operations. Optimal regulatory harmonisation requires that access and safety regulations are consistent where circumstances are comparable-this condition does not apply in the new regulatory environment. We noted that *optimal* physical harmonisation can mean long-term persistence of considerable physical non-standardisation because the high costs of standardisation and low traffic levels invariably lead to low financial returns on avoidable investments. By contrast, *optimal* regulatory harmonisation involves eliminating those inconsistencies. In the regulatory environment, the costs of resolving regulatory inconsistencies are low relative to the benefits. However, because the source of the inconsistencies lies in duplicated regulatory systems, differences can readily recur. Thus, the clearest and most stable approach to eliminating that regulatory disharmony involves removing the duplicated regulatory systems.

Diverse solutions do not require a multitude of regulators for each situation-it is sub-optimal to prescribe a single form of safety or access regulation. Nonetheless, regulatory optimality can be achieved and retained with a structure of national-based regulators.

What is the impact of industry players facing multiple access and safety regulators? When a player moves across interfaces, the bridging (transaction) costs potentially include significant management resources; this generates opportunity costs, especially for key safety managers. They also need to devote time to seek and *maintain* consistency, especially against unilateral regulatory decisions (which implies an inherently unstable regulatory system). Additional resources are also required for tailoring training and auditing to each system.

Since the establishment of these regulatory bodies in the 1990s, efforts have been made to maintain consistency. Despite this, safety and access regulation systems diverged from the outset. Ongoing efforts have been made to harmonise and simplify rail regulation and operation, with the establishment of ‘one-stop-shops’ (for track access), mutual recognition (for accreditation), and national safety legislation (transposed into States’ legislations). However, for example, in safety regulation, each jurisdiction takes its own view on risk and its own view on how to manage risk. Given such philosophical diversity, it will be a challenge to ensure that current efforts deliver the necessary harmonisation remedy for the current risk/risk management/jurisdiction matrix.

Similar conclusions can be drawn for access regulation, where each jurisdiction has investigated and established its own access principles and terms. Terms of access need, in particular, to reflect the commercial viability, industry regulation (vertically separated or integrated) or ownership of the railway. Those terms should not merely reflect the prevailing philosophy of a specific jurisdiction.

Introduction

In this chapter we consider issues of multi-jurisdictional regulation. This includes reviewing the principles of the optimal regulatory oversight. To the extent that deficiencies are identified in the structure, we also consider regulatory practices elsewhere, as a guide to alternative regulatory structures.

Having considered what is meant by 'optimal' regulatory harmonisation, we then review the different types of regulation. First, we review mandated access regulation, then safety regulation and safety monitoring/investigation. We then consider the costs and benefits of the current structure. Finally, we consider regulatory structure options.

Optimal regulatory harmonisation

The issue of optimal regulatory harmonisation is similar to that of technical harmonisation. As with technical harmonisation, there is a case for variation in regulatory oversight, depending on specific circumstances.

We should also note, however, that while regulations are intended to bring benefits, any regulation has its inevitable costs. There is an extensive literature on the returns and risks of regulations on an industry.

In this context, it might then seem to be a moot point that having multiple regulators for any given function—in this case, structural, access or safety regulation—may increase the likelihood of an adverse outcome. This is the case especially if the different regulatory practices do not converge.

But it should not be presumed that there should necessarily be convergence. As with technical issues, there is a case for a single system, or for compatible systems and for customised solutions. The bridging costs of different systems is a central concern.

The case for regulatory diversity

The case for customisation—diverse regulatory processes—arises for several reasons. It is important to identify, however, whether that diversity requires multiple regulatory systems. The reasons for diverse processes include those summarised below.

Industry/operation size.

In some areas and jurisdictions, the prospects for on-rail competition on a network managed by a given railway undertaking may be very limited. This can lead to perhaps only one train operator. In this circumstance, there would then be relatively few complex interfaces between rail firms. Consequently, there may be limited need for strong regulation in safety systems, access and structural regulations. Regulations could therefore be simpler than otherwise, For example, an integrated operator would not be required to ring-fence its train operations from track management.

Locational intensity of operation.

The more intense the railway is, the greater are the potential safety issues. This creates a greater need for processes to manage the risks. Further, more intense operations can lead to greater conflict over competing uses for track capacity and this may mean greater access regulatory oversight.

Railway viability

When traffic volumes and unit revenue are higher, it is more likely that a rival operator will seek to compete to haul the traffic. If the traffic is non-bulk, this may involve establishing a competing train service. For bulk traffic, it is likely to involve the operator competing for an exclusive contract to haul the goods. The access and economic regulations need to accommodate these different types of traffic. They must also tailor charges to reflect a sustainable level and structure—for example, choosing market—based or cost-based charges.

Traffic types

The types and levels of safety risk vary with the type of traffic. This is especially the case with passenger trains. Compared with typical freight operations, they involve greater potential personal safety risk due to the large number of persons on or near the railway relative to typical freight operations.

Geographical circumstances

The safety risk associated with a railway varies with topographical and demographic aspects. Flat, open terrain generally has fewer inherent risks than hilly, built-up terrain.

Policy diversity

The policy objectives of improved freight train coordination and on-track train competition on interstate track may be best achieved when train activities are separated from track management. However, this solution may not be optimal for other traffics.

Technical specifications and standards

Railway capital can be very long-lived. The choice of equipment and specifications can impact on the safety and operating practices adopted by a given railway. For instance, the choice of signalling systems will influence the way that a train driver will need to respond to line side equipment. Some systems are inherently safer than other systems.

Single-use versus mixed-use railway

The mixed-use (passenger and freight) railway involves more differential types of operation. These include train speed, stopping frequency, the weight and length of the train, and loading and unloading characteristics. This requires safety systems to be tailored to accommodate both systems.

Diverse processes arise because of specific topographical, policy or operational attributes. Note, also, that some of these attributes are correlated. As a broad categorisation—ignoring for the moment the topographical issues—the Australian network can be classified into four broad categories of operation and traffic intensity:

- intensive urban passenger operations;
- long-distance interstate freight operations;
- intensive, relatively short-haul bulk-haulage for ores, minerals and coal; and
- relatively low-intensity branch line grain haulage.

The urban railway is especially distinctive, having high-density operation, high safety risk levels and outcomes and is often a mixed-use-passenger and freight-operation. The political/constitutional overlay of urban railway provision is also very distinctive. It is important to note that State jurisdictions have strong urban transport policies. The consequence of this is that jurisdictions have a very hands-on approach to their urban railways. In this context, therefore, it was not surprising that when the South Australian government sold its railway operations (South Australian Railways) to the Australian Government in 1975, it excluded its urban passenger network (what is now TransAdelaide) from the sale. This feature of the urban 'islands' is therefore an important characteristic that need to be allowed for in identifying realistic options for regulatory harmonisation.

These urban railway political, operational and safety features have consequences for regulatory oversight. For instance, as a generalisation, the tone of safety regulation of urban operations will generally be very different from other parts of the network. Thus, across the network there will be similar circumstances that imply the need for common regulatory systems, such as common safety environments across urban passenger networks in major cities. The circumstances and the safety regulation that follows will be very different from what exists outside of those urban 'islands'.

It follows on from this that when considering reasons for regulatory diversity, the need for diversity is more likely to arise from *within* a regime—such as the difference between urban operations, bulk-haulage coal operations and low-intensity grain movements—than *between* regimes.

Is Australia's regulatory diversity optimal?

Regulations vary across jurisdictions. The extent to which these variances affect a firm will depend on the extent to which a firm operates across jurisdictions. There are approximately 200 separate accredited rail entities. Of these, 25 per cent operating across borders, 10 per cent are interstate operators and a further 15 per cent are rolling stock and infrastructure maintainers. (Transport SA 2004) While these cross-border entities do not dominate numerically they do dominate the non-bulk rail task performed. As noted in Chapter 2, interstate non-bulk freight comprised more than 90 per cent of the total non-bulk tonne-kilometre rail task in 2002–03.

The value of optimal regulatory, and technical, harmonisation has increased over time with the:

- growth in the interstate/inter-jurisdictional task;
- establishment of National Rail to operate intercapital freight, taking a national, coordinated approach to service delivery; and
- introduction of mandated access.

Thus, the Productivity Commission noted the heightened need for regulatory harmonisation, following changes to the industry and reflected that:

> Prior to the 1990s, differences in regulations between States were not of concern to operators because there was little scope for more than one operator in each system. (Productivity Commission 2000, p. 193)

More to the point here is that, ironically, as the cross-jurisdictional, or bridging, flows have increased, and as the interstate freight task has grown, so too has the degree of multiple regulatory systems. Operations face multiple regulatory oversight as well as multiple infrastructure management. Given the inherent risk that regulations undermine efficiency, they also undermine the railways' competitiveness to the extent they are much stronger than the road freight environment. Thus, one industry consultant has observed that:

> Potentially a single freight movement could require negotiation of access with four or more access providers, under the terms of four access regimes (and requiring accreditation from four rail safety regulators). This is a barrier to flexible operation of trains freely across the Australian rail network, and therefore to efficient intermodal logistics and effective competition. (Affleck Consulting 2003, p. 18)

Therefore, taking this view, the potential is for a train operator to have to negotiate with the different infrastructure providers. This duplicated effort is then compounded by the oversight of multiple access and multiple safety regulators in each jurisdiction.

In principle, the multiple regulators might not generate problems—if, in the way they operated, the rail firm saw seamless oversight and implementation. However, to varying degrees, a rail firm will be exposed to the consequences of inconsistencies in legislation and process. There are variations in jurisdictional Acts and regulations, with some differences in what is in the legislation and in the definitions used. Generally, there are differences in processes for mutual recognition[118] and accreditation, in auditing criteria and in treatment of competencies[119] and rolling stock certification.

118 The legislative underpinning of the principle of mutual recognition lies in the Commonwealth's Mutual Recognition Act (1992), with subsequent Trans-Tasman agreements from 1997.

119 It is notable that the European Commission's '3rd Railway Package', introduced in March 2004, includes a (draft) Directive on harmonising the certification of train drivers across the European Union. See Commission of the European Communities 2004, COM(2004) 142 final. The draft proposes two phases in the introduction of the harmonised certification: initially it will apply only to drivers operating on cross-border services. In the second phase, it will apply to all other drivers.

Thus there are rationales for regulatory diversity. However, the diversity is due to differences in finances, in operating characteristics of railways and in risks and risk levels—*not to jurisdictional borders*. Indeed, there are common circumstances requiring regulatory oversight but these can be treated differently from jurisdiction to jurisdiction. To the extent that a train operator, infrastructure manager, manufacturing firm or service provider operates across jurisdictions where the regulations differ for similar situations, then bridging costs will be incurred. We can deduce that such circumstances will involve non-optimal regulatory harmonisation. This provides the framework for the following discussion on optimal regulatory systems.

Regulatory overview

This section provides an overview of the types of industry-based regulations and the industry and external policy trends that have led to their adoption.

Forms of regulations

A rail firm is likely to face the consequence of differing standards and regulations when moving along the interstate network. This primarily affects freight operators.[120] These different regulations may exist because of different circumstances; but they are more likely to exist when crossing jurisdictional and infrastructure boundaries.

All industries face different regulations when they operate in more than one jurisdiction. However, what makes rail different from other industries is the extent of supplementary—that is, industry-specific-regulations. In aggregate, the two sets of regulations can lead to considerable bridging costs, especially when the bridging flows are substantial. One rail operator with large bridging flows is Pacific National. It comments that, as a national company undertaking business in all jurisdictions, it:

> ...expects a certain level of administrative complexity, it has to deal with the myriad different rules and regulations of no less than:

120 Notable interstate passenger rail operations are Great Southern Railway-operating the *Ghan, Indian Pacific* and *The Overland*-and CountryLink [RailCorp] which operates the Sydney-Melbourne and Sydney-Brisbane *XPT* trains. Manufacturers and service providers can also face different regulations.

- **Seven** Occupational Health & Safety Acts;
- **Nine** Worker's Compensation Acts;
- **Six** Rail Safety Acts; and
- **Six** Environmental Acts. (Pacific National 2003, p. 7)

Added to this list, national railway firms can also deal with multiple rail access regulators and multiple infrastructure managers.

Thus, an important issue is whether the regulatory diversity matches the diversity in operators' operating environment—such as safety risks—or whether it simply replicates the underlying jurisdictional pattern. The regulatory outcomes involve different solutions or interpretations depending on the jurisdiction. To the extent that this happens, it means that additional regulatory bridging costs will be incurred when business flows across the jurisdictional boundaries.

Publicly-built railways were traditionally self-regulated in access and safety. In principle their prices were set independently of government but often they were capped or structured by government directive. However, since the mid-1990s the railway regulatory umbrella has grown to embrace issues such as:

- **economic regulation**—regulated pricing/revenue;
- **mandated access regulation**—regulated access to infrastructure;
- **structural regulation**—the enforced separation of management and ownership of core railway infrastructure from train operation activities,[121] and
- **safety regulation**, including rail industry supplier, manager and operator licensing—that is, accreditation.

In much of the industry, the railway economic and access regulations effectively involve the same regulatory process. However there is a distinction between the regulations.

121 ARTC and Babcock & Brown (WestNet) are below-rail-only entities; QR is an integrated entity but has a ring-fenced infrastructure subsidiary (QR Network Access) while Pilbara, SA intrastate, Victorian intrastate and Tasmanian lines are currently integrated without ring-fencing. See also Table 4.1.

The Australian Competition and Consumer Commission has economic regulatory oversight of ARTC. As the vertically-separated infrastructure manager, the corporation has incentives to encourage access to infrastructure but *may* have some monopoly power. Given this power, which it could abuse, the regulator's main role is to review the reasonableness of the manager's charges—including its cost base. The commission must ensure that it is pursuing efficient provision and levying reasonable access prices.

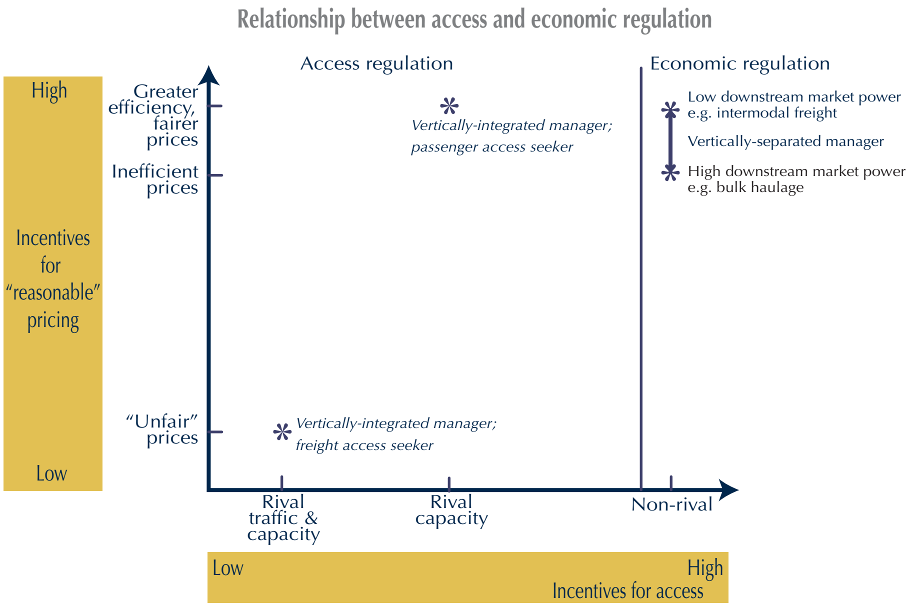
Each State and the Northern Territory,[122] have access regulators and, together with the National Competition Council, their regulatory oversight generally differs from ACCC to the extent the structural regulation differs. Vertically-integrated railways have an incentive to inhibit access to their infrastructure and to set onerous access terms. Regulators seek to ensure that access is not obstructed and that the terms of that access are reasonable. They oversee disputes that may arise between the infrastructure manager and the access seeker.

The different emphases of access and economic regulators are illustrated in Figure 4.1. There are fundamental differences in access and economic regulation. Access regulation focuses on integrated networks while economic regulation relates to vertically-separated networks. Access regulation is generally aimed at ensuring that access is available to train operators in a vertically-integrated system. The manager of the integrated system has some incentive to allow access to third parties because they can contribute to infrastructure fixed costs. But this is offset when there is the threat of competition for freight that would result from the same third parties. Thus, in Figure 4.1, even though a third-party operator can contribute to costs, the integrated freight railway manager will have less incentive to provide access.

Again, as illustrated in Figure 4.1, in some circumstances, such competition is not an issue—such as with passenger trains on a freight railway's tracks. In these cases, then, in principle, the integrated manager would set the access charge to reflect the opportunity cost of the train paths—that is, of track capacity. There is greater incentive

122 These primary State access regulators are the Queensland Competition Authority, the Independent Pricing and Regulatory Tribunal of NSW, Essential Services Commission (Victoria), the Essential Services Commission of SA and the Economic Regulation Authority (WA).

4.1 Economic and access regulation of a freight railway



to provide access to a passenger train access seeker because it is not a rival for traffic, albeit that it may be a rival for scarce train paths.

Conversely, access is not an issue for the economic regulator since the operating environment—vertically-separated railways—ensure access. However, here the emphasis is on efficiency rather than equitable access. Under a vertically-separated structure, the infrastructure manager's viability depends entirely on successfully negotiating mutually advantageous access conditions.

However, the scenario changes if the manager is a monopoly provider of a particular transport service where the train operator/shipper has high downstream market power—for example, bulk coal haulage operations. In that environment, access charges are accordingly set at a level to recover all long-run costs. Then the manager may have muted incentives to produce efficiently or may seek to shift a disproportionate share of its costs onto the access seeker.

These regulations complement the reforms that have transformed the railways' freight activities. Before these regulations were implemented, they were self-regulated, unitary State-owned entities operating within a single jurisdiction. Post-regulation, they are accredited, mostly-privatised and restructured national operations with mandated access to infrastructure.

Rationale for regulations

The following section discusses the influences that lead to the implementation of these new regulations in the last decade.

Economic, structural and access regulation was imposed on the industry in order to ensure:

- efficiency in monopoly infrastructure provision;
- improved horizontal coordination of infrastructure provision on interstate tracks; and
- fairness in terms and conditions of access.

Mandated access regulations were developed after all Australian governments agreed to National Competition Policy principles in 1995. These regulations are intended to permit third-party access to infrastructure where that infrastructure cannot be readily or economically duplicated.

Safety regulation was introduced to reflect the multiple-operator environment that has come with mandated—that is, third-party and open-access. This increased access led to a subsequent increase in operational interfaces in the industry, replacing railways' self-regulation.

In 1996 the Australian, State and Northern Territory governments signed the Intergovernmental Agreement on Rail Safety. This agreement sets out processes for rail safety, including accreditation. Industry entities have railway safety management systems as set out in State and Territory legislation. The agreement seeks to achieve cost-effective national consistency in rail safety regulation.

This regulatory trend is echoed in other countries where mandated access has been applied or contemplated, For example, in 2001, the panel reviewing the Canada Transportation Act acknowledged that if third-party access was to be mandated in that country, it would require considerable additional regulatory oversight:

> If access is provided, extensive regulation is required to oversee conditions of access and the price, to monitor safety and operations, and to settle disputes. (Canada Transportation Act Review Panel 2001, p. 22)

The move away from self-regulation has increased the focus on railways', train operators' and suppliers' operating and safety rules and procedures. These processes have been encouraged and enforced—sometimes through the accreditation process—by:

- legislation and implementing regulations;
- operating rule books;
- safety management plans;
- Australian Standards, especially AS 4292; and
- the Code of Practice.

External regulators supplant or supplement internal and political oversight. The rationale for their increase in the last decade stems from changes in government competition policy. An additional overlay here is that the regulations are set by each jurisdiction within the federal structure.

Regulatory reform and harmonisation initiatives

A consequence of the rapid—and fundamental—changes to the industry has been the institution of new access, safety and operational processes. Previously, integrated operators were largely self-regulated—apart from generic occupational health and safety legislation and environmental legislation.

Figure 1.8 illustrates the rail industry's current regulatory and operating parameters. One element of the framework is the operational protocols and working practices. As illustrated in the figure, working practices are a combination of self-regulatory systems and government-specified systems. Figure 1.8 highlighted the particular areas where operational parameters have developed in the last decade: access, accreditation, AS 4292 and Code of Practice.[123]

Some of the regulatory and standard-setting developments that brought this structure about are listed below.

(1) Inter-governmental agreements (IGA)

- National Competition Policy (1995) and the Competition Principles Agreement—rail is subject to the general principles of these agreements;
- National Rail Safety[124] (1996)—this set guidelines for accreditation and mutual recognition and seeks cost-effective national consistency in safety regulation;
- Rail Operational Uniformity (1999).

(2) Legislation

- the proclamation of the Rail Safety Act in each State and the Northern Territory—for accreditation (from 1993)—see Table 4.5.
- amendments to the Commonwealth's Trade Practices Act (Part IIIA) (from 1995);
- the proclamation of the *Transport Safety Investigation Act 2003*, to enable the Australian Transport Safety Bureau to investigate safety incidents on the interstate network;
- the announcement in 2005 of the establishment of national rail safety legislation, to be transposed into each jurisdiction's legislation.

123 Strictly speaking, the ARA Code of Practice embraces earlier code- and standard-setting by Railways of Australia (and which, in turn, adopts concepts developed by the Association of American Railways).

124 This IGA was developed in response to the 1993 report, A national approach to rail safety regulation.

(3) Standard-setting

- the development and implementation of Australian Railway Safety Standard AS 4292—published from 1995–97;
- development and institution of Codes of Practice for operations and standards—from 1999;

(4) Establishment of new rail regulatory functions

- accreditation authorities[125] in each State and the Northern Territory—from 1993;
- access regulators appointed in each mainland State for rail access[126] as well as the National Competition Council and the Australian Competition and Consumer Commission. A second regulatory entity was appointed in SA to cover the Tarcoola–Darwin line.

It is clear, therefore, that regulatory functions have developed in response to the significant changes in railway organisation and range of operation. Two related issues arise from this:

- establishing the optimal degree of regulation and regulatory harmonisation—or, conversely, diversity;
- identifying the extent of duplication of standards or regulatory activities.

These issues are considered later in this chapter.

Structural regulation

In recent years, the railway industry structure has been geographically regrouped. An example of this is the formation of major national, horizontally-integrated, operations such as National Rail/Pacific

125 From 2002, the Accreditation Authorities renamed themselves as Rail Safety Regulators.

126 We should note that, as currently established, the rail access regulatory oversights are undertaken within multi-industry, multi-function entities. In some cases this is a change with, for instance, the activities of WA's Office of Rail Access Regulation now being subsumed within WA's Economic Regulation Authority.

National and the ARTC. This has blurred the traditional jurisdiction-based railway structure and is illustrated in Figure 1.1.

The rationales for regulating the separation of infrastructure from train operation were three-fold:

- separating infrastructure maintenance from infrastructure management—such as with Rail Services Authority in NSW—was intended to facilitate the open tendering of track maintenance work;
- managing infrastructure under a single firm can improve the coordination of activities—in this case, with the ARTC's management of interstate tracks; and
- separating infrastructure ownership from train operation is intended to ensure that all train operators are given fair and unbiased access to the infrastructure.[127]

The intended benefits that flow from structural regulation are a key factor determining the nature of the regulation. Where there are relatively high traffic levels, greater benefits of financial or full management separation are assumed to flow from the greater competition on the track or greater competition for the traffic.[128] Stronger structural regulation may also be used to facilitate specific financing arrangements—for example, ring-fencing on the Darwin operation. This has enabled a unique financing/access regime to be established.

Benefits and costs are important factors that can lead to diverse outcomes in structural regulation. Costs arise from this regulation. They include:

- regulatory and industry administration costs;
- compliance costs in how the business is operated; and

127 The reasoning is that a vertically-integrated railway operator will always favour its own train operations over a third-party train operator, in financial, operational and timetable decisions. By contrast, a vertically-separated infrastructure manager is assumed to be indifferent between (or at least less likely to favour) specific operators.

128 An example of on-track competition is Pacific National's Brisbane-Cairns intermodal train, in competition with QR's train. Examples of competition for the market include the contract to haul coal between Leigh Creek and Port Augusta.

- possible efficiency impacts when synergy is lost from the separation of infrastructure management from train operation.

Thus, if the regulation is to be imposed then the coordination and competition benefits must outweigh those costs.

It is not surprising then that the structural regulation takes different forms. The rationale for individual structural regulations arises from the balance between the benefits and costs arising from the regulations—although it is not necessarily consistent. The ownership of infrastructure is illustrated in Table 4.1.

The strongest form of regulation is where train and infrastructure management are separated. The operational structure of interstate, principally ARTC, infrastructure has also been fundamentally changed. Legislation has forced the separation of rail infrastructure management from train operation management. This separation has also been applied in NSW. Significant developments in this structural regulation have been the formation of Rail Access Corporation and the establishment of the ARTC. Rail Access Corporation (RAC) was established on 1 July 1996 from State Rail Authority infrastructure assets and its role was to manage standard gauge rail infrastructure in NSW. The new Rail Infrastructure Corporation (RIC) was established when RAC was reintegrated with the Rail Services Authority (which undertook track maintenance for the Rail Access Corporation). In 2004, RIC's urban assets were merged with the *urban* State Rail Authority above-rail (train) assets, to form a re-integrated *railway* operator in the greater Sydney area. RIC's non-urban operations remain vertically-separated but, since September 2004, have been managed by ARTC.

ARTC was established on 1 July 1998, from the intercity assets of Australian National Railways Corporation and leased interstate V/Line Freight infrastructure. It now manages most of the interstate network, having subsequently taken up leases over NSW's interstate track.[129]

In Queensland and Western Australia, the structural regulation involves only the separation of infrastructure management and train-operating activities—known as 'ring-fencing'—rather than separation

129 ARTC also manages other NSW track (Country Regional Network) on behalf of the NSW Government.

of ownership. That is, the railway remains integrated. Separation of management is intended to display transparency in transactions, to demonstrate the infrastructure manager's impartiality in dealing with its own and third-party train operators when mandated access regulation is applied. However, it may be that, rather than enforcing vertical separation, the merits of ring-fencing may depend on intangibles such as the cooperation of the infrastructure manager and efficacy of the regulator.

Cost has been a factor influencing the scope of structural regulation in Victoria. The proposed new Victorian regime would require ring-fencing of activities. The intrastate freight infrastructure manager is currently not required to do this. Victoria's Department of Infrastructure has concluded that the new regulatory structure should not require structural separation, '…to minimise regulatory cost'. (DOI 2004a, p. 14)

The benefits flowing from separation or ring-fencing are equally factors that influence the degree of structural regulation. The lines in Tasmania and SA have not warranted ring-fenced regulations. This is presumably because there is very little traffic on the railways and thus, little likelihood of third-party access.

If we consider optimal regulatory harmonisation, it is not apparent that the diverse structures set out in Table 4.1 mean that a standard approach should be adopted across the nation. That is, that either a separated model or an integrated model should be universal. This is because, as in optimising technical harmonisation, there are issues such as market strength and power that point towards customised outcomes. The BTRE (2003) observes that trade-offs arise with regulating the industry structure—and these trade-offs differ across the network. Thus, the vertically-separated structure is likely to deliver access and impartial infrastructure charges that may not be otherwise achievable—even with strong regulatory oversight. These benefits may be small or large, depending particularly on the traffic levels and the extent to which resulting competition then drives up efficiencies. The level of benefits is an important factor as they may be totally offset by other factors:

> A vertically-separated structure is likely, however, to be more costly to establish than an internal separation of activities. ...separation may

4.1 Infrastructure management of primary railways in Australia [a]

Structure	*Organisation*	*Ownership*	*Primary location*
Vertically separated	Australian Rail Track Corporation (ARTC)	Public	SA (interstate); Vic (interstate); WA (interstate, west to Parkeston); NSW (mostly outside Sydney) c
	Babcock and Brown (WestNet)	Private	WA (interstate, west of Parkeston, southern intrastate track)
Vertically integrated	Queensland Rail (QR)	Public	QLD
	Genesee & Wyoming Australia [e]	Private	SA (some intrastate tracks)
	NRG [b]	Private	SA (Leigh Creek-Stirling North)
	Asia Pacific Transport	Private	Tarcoola-Darwin
	Pacific National	Private	Tasmania and intrastate Victoria [b]
	BHP-Billiton	Private	WA (Pilbara)
	Pilbara Rail (Hamersley/Robe)	Private	WA (Pilbara)
	Onesteel	Private	SA (Middleback) [d]
	Comalco	Private	QLD (Weipa)
	RailCorp (CityRail)	Public	Sydney/Newcastle
	TransAdelaide	Public	Adelaide (broad gauge)
	Transperth	Public	Perth
	Connex	Private (public franchise)	Melbourne

a Excluding 'heritage' railways
b Pacific National also manages infrastructure in NSW (for example, Elura Mine-Cobar) and SA (Stirling North-Leigh Creek, for NRG).
c Broadly, ARTC owns its managed tracks in SA and WA, leases interstate track in Victoria, leases interstate and secondary main line track in NSW, intends to lease the Metropolitan Freight Network in Sydney and, on behalf of the Rail Infrastructure Corporation, manages the Country Regional Network in NSW.
d Genesee & Wyoming Australia operates these lines on behalf of Onesteel.

> improve the ability to coordinate activities *along* the rails (that is, between railway networks), [but] coordination *between rail and train* becomes more difficult. Separation brings with it greater ongoing transaction and coordination costs than under integration. ...Thus, if the likely on-track competition will be modest (due to small freight movements), the relatively low resulting benefits may not warrant the costs of vertical separation. (BTRE 2003, p. 9)

The rationale for the form of structural separation adopted on most of the interstate network is clear. The vertical separation on ARTC track is associated with relatively strong benefits. This part of the network has relatively large volumes of traffic—sufficient for some competition or contestability. In addition, the separation gives benefits to the extent that separation assists the horizontal integration of the interstate network. The vertically-separated model facilitates unitary management of the infrastructure and therefore improves operational coordination. In this context there is a stronger case for separation for this part of the network.

The regulation is applied by State legislation to firms that may be State-based. This means that a given regulatory structure is necessarily being applied to networks of low—and high-trafficked lines. Nonetheless, even where networks have similar traffic mixes, such as NSW and Queensland, different regulations are applied. Both States have rail tasks founded mostly in large bulk coal movements. But Queensland has applied an integrated model with ring-fencing while NSW has adopted a separated model.

What is the impact of the inconsistencies? To the extent that different degrees of structural regulation are adopted in different jurisdictions, it can lead to the need for different principles underlying the respective access regimes. This means that firms that operate across the regulatory bridge face additional transaction costs arising from understanding the different systems. The fact that regulatory environments differ also impacts on the practicability of achieving consistency in other regulations—both safety and access.

Mandated access regulation

In this section the authors consider a range of aspects of mandated access regulation, which differ across and within jurisdictions.

What is covered by regulation

There are two aspects to mandated access regulation: the oversight of the *right* to access infrastructure and the oversight of the *terms* of access.

As a general point, readers should note that identifying which assets are mandated can be a matter of judgment or individual assessment. Ultimately, this can also affect the terms of access. Thus, note that a specific railway may not be subject to mandated access regulations. A related aspect of this is that access *for specific services* *along the railway* can also determine whether the infrastructure makes it subject to mandated access regulations. For example, in the case of the Victorian Rail Access Regime, passenger services are excluded from the Regime.[130] Finally, we note that some infrastructure *along a railway* may be exempt from the regulation, such as terminals and sidings.

Since the National Access Regime was established, there have been court cases considering whether specific railways should be subject to the mandated access. The issue has arisen, in particular, in the case of railways in the Pilbara. For instance, in 1998, Robe River Iron Associates sought access to rail track operated by Hamersley Iron Pty Ltd. Hamersley argued that the track was an integral part of its production process. Its case was that, under Part IIIA of the *Trade Practices Act*—which sets out the principles of the National Access Regime—the railway therefore was not a service as defined in the Act. The Federal Court agreed with this interpretation and the facility was therefore argued to be outside the scope of Part IIIA. The regulation is subject to such considerations. Part IIIA was also used when the Fortescue Metals Group sought access to BHP Billiton Ore's Goldsworthy and Mount Newman railways in the Pilbara. The NCC concluded that Goldsworthy was part of a production service, and therefore not a service, whereas 'the use of the relevant part of the Mount Newman railway line was not [part of a production process]' (NCC 2005, pp. 2–3). Thus, the Council concluded that only the Mount Newman railway line is a service for the purposes of Part IIIA and therefore open to declaration.

Thus, which railways are subject to the National Access Regime depends on the individual circumstances of how transport features within the overall production process. It is notable that, on the face of it, this interpretation is not a function of the jurisdiction in which the application for access is being made.

There is divergence across and within jurisdictions about what infrastructure access on a given railway is mandated. In some cases, such as the Western Australian regime, terminals and sidings are excluded. The WA's Economic Regulation Authority rationalises this decision as being:

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130 See, for instance, ARTC 2004d, p. 11.

> ...because it was deemed they did not exhibit nationally significant infrastructure characteristics and use by multiple parties may not be practical. (ERA 2005, p. 35)

However, while this criterion can be used to exclude, for instance, sidings from a regime, other criteria can be used to justify inclusion of the assets. For example, currently the Victorian intrastate access regime includes the Melbourne Dynon terminals but sidings and yards are excluded. As the Victorian Department of Infrastructure (DOI) notes, however, access to sidings '...may be reasonably necessary to ensure effective access to the primary or mainline network'. This was evident in GrainCorp's efforts to gain access to Freight Australia's grain sidings in Dimboola (DOI 2004b, p. 6).[131] For this reason, one proposed revision to that regime would be to include sidings within the terms of the access regime.

The authors conclude that the nature of different railways, such as the Hamersley Iron line and the Goldsworthy line, may lead to different interpretations of the role of the railway in the overall logistics or production process. This influences whether such assets are subject to the National Access Regime. Given the common principles set out in the National Access Regime, decisions on third-party access should be consistent irrespective of the jurisdiction.

We observe that for specific railway assets—especially terminals, sidings and yards—there is no consistent approach across jurisdictions. The inclusion or exclusion of assets across jurisdictions depends on different criteria. There is also the arguably confusing definition of an access regime based on the type of train service. For example the Victorian intrastate access regime refers only to freight services—passenger train services are excluded.

Inconsistencies will impact on services if they prevent a train service running. This can happen when access to specific assets is mandated by a jurisdiction at one end of a freight operation but not at the other end.[132]

131 Even though GrainCorp trains could readily use adjoining ARTC mainline track to move the grain, they could not load the grain from the silos as the silos were serviced by Freight Australia sidings.

132 This observation does not presume to infer, however, that access to those assets should be mandated.

Rationale for access regulators

Mandated access can bring with it the need for regulatory oversight. The terms of access that are set by the access provider may not be acceptable to the access seeker or the provider may try to prevent third-party access. An access regulator may be required to arbitrate on access terms.

The requirements for regulatory oversight differ between integrated and separated railways. Sometimes access seekers intend to compete for the integrated railway infrastructure manager's traffic. In those cases, managers have an incentive to offer unfair terms of access relative to those that it charges for its own train services. The regulator will, therefore, need to ensure that unfair access terms are not used to frustrate that competition. By contrast, vertically-separated infrastructure managers do not operate train services from which revenue could be abstracted. Because of this, in most cases, the vertically-separated infrastructure manager will encourage access seekers. Here, the regulatory oversight is intended to ensure that users are offered reasonable charges and that processes are in place to encourage managers to optimise their efficiency.

Consequently, the nature of access regulation will necessarily depend upon the form of regulation applied to the industry structure—that is, whether or not the railway has been vertically separated.

Negotiating access

The environment for access regulation therefore varies with the form of structural regulation applied within a jurisdiction. The infrastructure manager's willingness to negotiate will depend on the type of business that the structural regulation permits. This has implications for the extent of involvement by an access regulator in ensuring that there are fair and equitable terms of access.

Vertically-separated infrastructure manager negotiating with non-rival third parties

Here, the infrastructure manager's revenue comes entirely from selling train paths to third parties. The manager therefore has strong incentives for converging upon agreeable access terms without external regulatory involvement.

Vertically-integrated infrastructure manager negotiating with non-rival train operator

If the access seeker is not a rival train operator—such as passenger train operators seeking access to the freight railway—the infrastructure manager should be willing to negotiate terms. The manager will be willing to negotiate with the access seeker provided there are spare train paths available. In this circumstance, the manager is also likely to ensure that fees are paid for giving priority to passenger trains, and that charges include incremental costs incurred.[133]

Vertically-integrated infrastructure manager negotiating with rival freight operator

Here, the integrated freight railway operators are likely to see third-party freight access seekers as threatening their own freight revenue. Consequently, they will be less inclined to encourage access and see less incentive to negotiate access terms that would be acceptable to the seeker. Thus, incentives for convergence are weak.

Given this, because structural regulation differs across jurisdictions, then varying degrees of access regulation oversight are required. The Western Australian Economic Regulation Authority (2005, p. 23) suggests three categories of regulatory involvement:

- *ex ante*—generic terms and conditions of access are established at the outset;
- *ex post*—the regulator's role involves arbitrating, and ultimately setting, terms and conditions of access; and
- *hybrid*—the regulator has a greater degree of involvement throughout the access-seeking process and some greater specification of floor/ceiling pricing and principles.

However, the nature of the regulation does not necessarily align with the variation in infrastructure managers' incentives to negotiate an agreement. As a vertically-separated manager, ARTC's posted, or published, charges facilitate regulation with ex ante oversight,

133 For Freight Australia, access charges received from V/Line Passenger country rail services were an important revenue source, representing 15 percent of its revenue in 2002. (BTRE 2003, p. 93)

underpinned by the regulator's endorsement of its reference charges. Here, the regulator is essentially removed from the negotiating process.

For the integrated railways—with their incentives to frustrate access by third-party rivals—most regulatory involvement belongs to the hybrid approach. However, QR Network Access's individual coal line charges are posted and the regulator adopts an essentially ex ante approach. By contrast, the Economic Regulation Authority considers that the Victorian regime is classed as 'largely an ex post' approach. (ERA p. 24)

In situations where the financial stakes of the negotiating process are high for access seeker and provider, then greater oversight throughout the process is probably more efficient than ex post oversight. In this context, jurisdiction-based regulatory systems and access providers enable regulatory involvement to be tailored to reflect those financial stakes. However, this scenario excludes ARTC.

Rationale for economic regulation

A subset of the terms of access agreed between infrastructure managers and train operators is economic—that is, pricing and revenue-regulation. This regulation relates only to ARTC. Again, as with the process for negotiating access, this differential approach to regulation across jurisdictions arises because of differential structural regulation.

The Australian Competition and Consumer Commission (ACCC) is ARTC's economic regulator. The basis of the need for regulatory oversight focuses on whether the corporation has monopoly power. In principle, the infrastructure provider has commercial leverage to raise its charges if the train operator is not price-sensitive. This may arise when train operators have a strong competitive advantage over other modes or where the operator has made substantial rail-specific investments (ARTC 2002, p. x). Nonetheless, ACCC recognises that:

> ...the general freight transport market that ARTC serves is subject to a relatively high degree of intermodal competition. Accordingly, the extent to which ARTC would be able to extract rents is very limited. That said, there might be some customer segments in which ARTC holds, or may in future hold, some market power. For these reasons, the Commission considers it important to ensure that the Undertaking does not allow it to abuse market power. (ACCC 2002, p. 116)

Consequently, the regulator exercises some pricing and revenue oversight, to ensure that train operators are levied fair and efficient access charges.[134] Even where a vertically-separated infrastructure manager does not have such power, the commission has noted that:

> …separated infrastructure managers nonetheless have commercial leverage over non-bulk train operators to the extent that the operators have significant 'sunk' ancillary rail investments (such as dedicated terminals) (ACCC 2001b, p. iii). For this reason, it may be argued that a degree of oversight of access charges is still required where rail's market power is weak; this oversight would provide incentives for productive efficiency and to prevent monopoly pricing abuse. (BTRE 2003, p. 10)

However, this argument also applied to ARTC. It outlays considerable funds in infrastructure that can also be 'sunk'—and this may be a potentially significant risk to it. To the extent that the corporation bears all the risk of a given investment, it would be up to the regulator to assess the extent to which the consequent financing premium could be levied on the train operator. By making the investment a joint venture with train operator beneficiaries, the sunk cost risk could be shared. However, in such situations, the regulator would need to be assured that the venture did not undermine the structural regulation. That is, assurance is needed that train operators who are not part of the venture are not discriminated against.

Integrated railways are not subject to these regulations because access charges are levied on its own train operations as well as the third-party's operations. The integrated operator's third-party charges are consistent with the charges it levies on its own train operations. Because these charges affect its own bottom-line, it is in its own interests to set efficient charges.[135] The regulatory oversight is intended, however, to ensure that the charges are fair. Further, it is in the interests of the incumbent for these charges to be 'efficient'. However, integrated access regime principles normally stipulate that

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134 ARTC's charges are not regulated in the form of formal price ceilings, such as CPI-x price/revenue capping. However, in its Access Undertaking to the ACCC it has committed to annual adjustments in its reference prices using such an approach.

135 One notable exception is where the AustralAsia Railway (Tarcoola-Darwin) has charges that implicitly favour the incumbent over a third party.

if charges are arbitrated they should be based on the regulator's definition of efficient charges.

Regulatory oversight

There are several authorities involved in regulating the terms of mandated access and ruling on access terms. These authorities include the:

- Australian Competition and Consumer Commission (ACCC);
- National Competition Council (NCC);
- Independent Pricing and Regulatory Tribunal of NSW (IPART);
- Queensland Competition Authority (QCA);
- Essential Services Commission of Victoria (ESC);
- Essential Services Commission of South Australia (ESCOSA); and
- Western Australian Economic Regulation Authority, Rail Division.

In essence, these authorities provide substitutable roles for train operators and track managers seeking to formalise, or seeking adjudication, over access terms.

Obtaining access

The legislative background behind mandated access is set out in Part IIIA of the Trade Practices Act. There are three different ways in which terms of access to rail infrastructure can be formalised:

- by way of a voluntary 'undertaking' to the ACCC;
- by way of 'declaration' of the services through the NCC; and
- by 'certification' of the access regime as being 'effective', by application to the relevant State or Territory authority—which is then assessed by NCC.

Inevitably, these different forms of formalisation complicate the processes of open access and third-party access. Table 4.2 illustrates the primary areas of rail infrastructure. Readers should note that, to date, access to privately-built railways has been assessed on a case-by-case basis. With the exception of Tasmania, there is a different presumption for traditionally-public railways. For those, the presumption embodied in the infrastructure declared in access regimes has been that the facilities are essential and, therefore, that access should be granted to third parties.[136]

Multiple access regulatory systems have three consequences:

- they have added complexity and require additional resourcing in the regulatory process where railway structure would otherwise imply a common approach to terms of access for each classification of traffic. For example, the integrated railways in SA, Victoria, Tasmania and Queensland;
- there has been only patchy success with enforcing access. For example, freight train operators' failure between 2002 and 2004 to get access to Freight Australia infrastructure whereas some third-party access has been achieved with other access regimes;[137] and
- explicit overlapping of regulatory processes. This is illustrated by Freight Australia's application to the NCC for its infrastructure to be 'declared' and the Victorian Government's application to the Council for its access regime to be 'certified'—see Table 4.2.

Formalising an access regime, and a regulator's arbitration to ensure fair access to infrastructure, are complex processes. The scale of these tasks is clearly illustrated by regulators' deliberations and the number, and scale, of interested parties' submissions to access regime inquiries. These considerations do not vary with geography or local circumstances, as might be argued for safety regulation. The principal areas where there are clearly different considerations that require markedly different regulatory considerations are in the areas of access

136 The NCC has established criteria to assess what are 'essential' infrastructure facilities. These criteria are that (a) access promotes competition in another market (b) it is uneconomical to duplicate the facility (c) the facility is of 'national importance' given its size, importance to trade/commerce or national economy (d) access can be provided without risk to human health or safety (e) access is not already subject to a formal access regime and (f) access or increased access would not be against the 'public interest'.

137 These freight successes include Pacific National trains on QR Network Access track, Brisbane-Cairns and various operators over ARG WestNet track, Kalgoorlie-Perth.

to vertically-separated infrastructure and private railways. As discussed earlier, infrastructure access can involve issues of economic regulation, as in the case of ACCC oversight of ARTC. Infrastructure access can also involve issues of whether access should be mandated, such as with access to non-traditionally public railways. For these railways there have been two major court cases—the 1999 Hamersley Iron—Robe River case (discussed earlier in this chapter) and the 2004 BHP Billiton—Fortescue Metals case.[138]

Finance, practical operational factors and market considerations may provide a basis for diversity in railway access terms. For example, to reduce the risk profile on new, large-scale railways, terms of access for new railway investment (such as the AustralAsia Railway) are generally markedly different than for existing railway assets. See BTRE 2003, p. 146. Terms can also vary where the infrastructure manager and a train operator negotiate a joint-investment scheme. An example of this is the Railtrack—Virgin Trains agreement for the West Coast Main Line upgrade in Britain[139] (see BTRE 2003, p. 145) Similar provisions exist in the draft NSW Rail Access Regime (RIC and RailCorp, Schedule 3, Page 2) for an infrastructure manager and a train operator to negotiate a joint investment scheme. Nonetheless, these investment considerations can be incorporated within the umbrella of general rail access terms—as the draft regime illustrates—rather than requiring a separate consideration in each jurisdiction.

Australia has taken the policy trend in mandated access to railway infrastructure much further than other countries that have implemented mandated access. In other countries, the railways are invariably publicly-owned and receive substantial subsidy to underpin the operations and investment funding. By contrast, Australia's mandated access is being applied to private-sector, for-profit railways. In this environment, even if mandated access does not adversely

138 Fortescue Metals seeks access to part of BHP Billiton's Pilbara railway network. See NCC 2005. Note, also, the BHP Billiton—Hancock Mining case, considered in the WA Supreme Court in 2003, with access being sought through State legislation.

139 In a similar vein, in 2004, the UK Department for Transport unveiled its concept of local partnerships between individual train operators and the infrastructure manager (Network Rail), a concept titled 'Virtual Vertically Integrated Companies'.

4.2 Rail access status, by infrastructure manager

Infrastructure manager [b]	*Primary location*	*Rail access regime*	*Process of formalisation*	*Status* [a]	*Date of formalisation or decision*
ARTC (IM)	SA, Victoria (interstate track),	✔	Undertaking	Undertaking (to 2007) for SA/ Victorian track approved by ACCC	May-02
	NSW (interstate and secondary)		Undertaking forthcoming	Separate Undertaking for NSW track	-
Rail Infrastructure Corp (IM) [c]	NSW (Country Regional Network)	✔	Certification	Certified by NCC; (Nov. 1999–Dec. 2000) lapsed.	
Babcock and Brown/ WestNet (IM)	WA non-urban intrastate track	✔	Certification	Submitted by State Govt to NCC; withdrawn by State Govt	Feb. 1999 Nov. 2000
Pacific National (RO)	Victoria (intrastate freight track and Dynon terminals)	✔[g]	Declaration	Submitted by FA to NCC; rejected	Feb. 2002
			Certification	Submitted by State Govt to NCC; withdrawn August 2002	Jul-01
Pacific National (RO)	Tasmania	✖[e]	-	-	-
Genesee & Wyoming Australia (RO)	SA (intrastate)	✔	Will not seek certification	-	-
Asia Pacific Transport —AustralAsia	Tarcoola–Alice Springs (leased)–Darwin	✔	Certification	Certified by NCC (full line length prescribed from 2004 to 2030)	Feb. 2000
Railway (RO)	Wirrida–Tarcoola [a]		Declaration	Following application from Aulron Energy Limited, Parliamentary Sec. to the Treasurer has declared this section of track for a period of five years—decision set aside [f]	Sep. 2002/ Mar. 2003
Queensland Rail (RO)	Queensland [d]	✔	Certification	State Govt sought certification from NCC in 1998; withdrawn 1999.	
			Undertaking	Approved by Queensland Competition Authority (to 30 June 2005)	Dec. 2001
Pilbara Rail (RO)	Hamersley (WA)	✖	Declaration	Access seeker (Robe River) withdrew application from NCC; access subsequently given when seeker was partly taken over by infrastructure owner (Hamersley)	Jun-99
BHP Billiton Iron Ore (RO)	Newman/ Goldsworthy (WA)	✖	Declaration	Access seeker (Fortescue) submitted application to NCC; rejected	May-2006
NRG	Leigh Creek–Stirling North (SA)	✖	-	-	-

a In addition to those listed here, there have been applications made for declaration of parts of the infrastructure: by Carpentaria Transport (over QR Brisbane–Cairns); by SCT (Sydney–Broken Hill, over RIC); by SCT (5 sections of track in WA); and by NSW Minerals Council (Hunter Valley lines, over RIC).

b RO: Vertically-integrated railway operator; IM: Vertically-separated infrastructure manager

c Excludes broad-gauge lines in southern NSW, which are under the Victorian access regime. From 2004, Sydney metropolitan area track is managed as an integrated urban operation by RailCorp. ARTC has leased NSW's interstate and Hunter Valley tracks from the NSW Government and is managing most of the other non-urban track (Country Regional Network) on behalf of the NSW government.

d Excludes the standard-gauge line from NSW border to Brisbane, which not under a formal access regime, though QR provides third-party access.

e The Productivity Commission reports that Tasmania has no formal access regime but the infrastructure manager is 'required to enter into negotiations with other operators wishing to use its infrastructure through obligations contained in its contract of sale' (PC 2000, p. F21) Despite the absence of this formal regime, however, the incumbent and 'a number of other operators' have successfully negotiated access terms (PC 2000, p. 49).

f In October 2002, Asia Pacific Transport applied to the Australian Competition Tribunal for review of the declaration; in March 2003, the Tribunal decided to set aside the Minister's declaration decision.

g The Victorian intrastate access regime was being reviewed in 2004, with the intention that it be revised.

Source: Based on BTRE 2003 Table 5, p. 64

affect profit or investment incentives, profit must be sufficient to justify long-term re-investment in infrastructure.

The BTRE (2003, p. 183) observes that there are no examples outside Australia of private, integrated rail operators facing the efficiency-incentive regulation that has been adopted for Australian operations. More generally, the bureau highlights '...the extent to which access charge setting is occurring in "unchartered waters"'. Thus, limited overseas experience with mandated access regulation provides little evidence that there is a proven regulatory model.

Therefore, a range of terms of access is being developed that varies by regulatory interpretation and not necessarily by optimal outcome. This is a consequence of multiple access regulators operating without a robust, proven model of railway regulation. There is little experience with setting access terms that are fair to access seekers but do not discourage infrastructure managers from retaining and investing in their business.

Access charges

Charging levels and structures

Australia does not have a single rail infrastructure pricing system—whether defined in charging levels, structures or principles.[140] There are some features that are generally common. For instance, access charges are normally required to fall between a 'combinatorial' [141] floor price and a ceiling price. However, there is divergence at the detailed level. Across and within regimes:

140 A detailed analysis of rail infrastructure pricing principles and practice in Australia and overseas is set out in BTRE Report 109 (BTRE 2003).

141 The 'combinatorial' aspect of the pricing sets the floor or ceiling revenue to be the *combined* floor or ceiling revenue of all the operators on a given segment of line for which a specific access charge is being allocated. In practice, the combinatorial test is really a multitude of tests applicable to every combination of traffic (including total traffic) that operates on the network. One aspect of the approach is to ensure that cross-subsidisation of market segments does not occur, by having each line segment free-standing. It is used, for instance, for coal networks, to ensure that mines do not cross-subsidise each other. See Smart (1999) for further discussion of the principles of combinatorial pricing, as applied by Rail Infrastructure Corporation.

- there may be no consistency of definitions of the floor price or the ceiling price;
- in Victoria, there is no such regulatory band;
- the charges are usually, but not always, structured as two-part prices, with a flagfall charge and a variable charge;
- the charges are generally subject to negotiation; and
- the charges are not based closely in underlying costs although they are likely to shadow changes in intensity of use.

The consequence of these parameters is that charges will therefore differ across infrastructure managers as well as within managers' networks.[142] In addition, access charges will also vary across jurisdictions. For example, Pacific National has noted that the NSW Office of State Revenue intends to levy railway access agreements as being a lease of land, setting a charge of 0.35 per cent of the total access charges of the lease agreement (Pacific National 2004, p. 13).

Access charging structures and levels are illustrated in Appendix II. Should charges be harmonised? There are several factors that show that some pricing diversity is desirable. Charging levels will vary to reflect a range of factors including the:

- freight, or other, market for the goods that the train is conveying;
- ability to Ramsey price across users, to improve cost recovery;[143]
- relative levels of wear-and-tear to the infrastructure arising from the different types of locomotives and rolling stock being used;
- level of congestion on the track;

142 See also Bassanini and Pouyet 2003.

143 The principle of Ramsey pricing is that if users' valuations of the product vary, then different prices could be charged to recover the unattributable costs or at least achieve relatively high cost recovery. Access charges would be set in relation to the users' responsiveness to prices. Charges would be set higher above marginal cost for those users who are least responsive to the price changes-in this case, train operators who have shippers with a low price elasticity of demand. Conversely, access charges would be lower for train operators who have shippers that are highly responsive to prices (freight rates).

- priority, and speed characteristics, assigned to the train relative to other trains;
- amount of track capacity being used by the train; and
- extent to which other operators use the line—that is, combinatorial pricing.

However, the charging level does not necessarily relate in any way to any underlying costs. This is illustrated by ARTC's 'market-based' pricing for its non-bulk traffic—essentially pricing at what the freight market will bear. It is a pricing principle that is central to the Corporation's commercial strategy. Indeed, in its submission to the Productivity Commission's inquiry into National Competition Policy, the corporation has argued against '…inextricably linking access pricing to costs' that would require prices that at least cover the efficient long-run asset costs. This pricing would prohibit infrastructure managers from taking on the commercial risk of setting lower charges that are designed to encourage traffic growth that increases asset utilisation (ARTC 2004, p. 13).[144] Thus, while we might interpret ARTC's fixed access charge as being a charge for entry onto the network, the level of this charge should not be presumed to reflect fixed overhead costs. That is, costs that are incurred irrespective of the infrastructure being used.

Charging structure will vary to reflect infrastructure managers' strategies for profit maximisation.[145] The structure may involve applying a two-part pricing structure, consisting of a fixed charge component and a variable component—as illustrated in ARTC's two-part pricing structure. By contrast, marginal grain railways in NSW use a single, variable, charge.

The charging structure may also be modulated, (that is, varied) to reflect the train economics. The train economics can be strongly influenced by the nature of the track and terminal infrastructure and the type of goods being transported. The time sensitivity of the goods

144 Put another way, ARTC seeks to ensure that it can retain its market-based pricing policy.

145 Profit maximisation is assumed to be the objective of all the traditionally public infrastructure managers as they are all privately-owned companies or public corporations that are subject to corporation law.

will influence the speed with which goods are delivered. The train economics impact on various train operating, or modulating, parameters, including:

- train speed;
- wagon mass and volume;
- train length; and
- train frequency.

Thus, it will be important for the infrastructure manager to have the flexibility to set access charges that are consistent with the prevailing train and track economics. For instance, if some goods are time sensitive, the shipper may not wish the goods to sit at the terminal while sufficient goods are consolidated to form a long train. Similarly, if there is limited terminal capacity, it may be operationally inefficient to assemble a long train. An access charge based on a large flagfall charge per train combined with a relatively low variable charge can work against the market and terminal parameters.

As noted earlier, diversity in charging levels and structures may be preferred to harmonisation in several circumstances—including new investments. In this context, the pricing principles of the AustralAsia railway differ significantly from those adopted in other regimes. For this regime, the different pricing principles recognise the high risk and uncertainty of investment—and especially here, where there is substantial new investment. Similarly, the Draft NSW Rail Access Undertaking permits the infrastructure manager to enter into flexible agreements. These enable both exclusive use of new investment assets and charges that permit up-front recovery of the capital costs, accelerated depreciation and a risk premium beyond the regulator's approved rate of return (Rail Infrastructure Corporation, et al, 2004, Schedule 3, p. 2).

Thus, there is no presumption that charging levels and charging structures should be identical across the system. The level and structure of access charges needs to be flexible. They must reflect the infrastructure and train operating economics and the requirements of the goods and passenger markets that are being catered for. However, it is an unnecessary level of diversity when charges for like-services and financial circumstances differ across jurisdictions.

Cost principles and measurement

Some traffic is priced using market-based charges. However, charges can also be based on costs, particularly when full cost recovery is achievable. An appreciation of costs is also required for some parameters such as when floor and ceiling price bands are being considered. Here, then, the industry will focus on whether consistency can be achieved in the principles and measurement of costs of infrastructure provision and usage.

Cost principles

Infrastructure charges may be set by reference to what the market will bear, that is, market-based. Alternatively, charges may be cost-based—such charges are more likely to be set this way when it is possible to recover long-run costs of the relevant section of railway line. Regulators sometimes intervene in the infrastructure charge-levying process—by formalising the charging system[146] or having the charges set by arbitration. When this happens, they consider using a common set of principles. Inevitably, this is important where charges are cost-based. There are long-outstanding differences in the principles of usage costs.

Using common principles is particularly pertinent to asset valuation. For instance, in economic terms the value of any assets (including sunk assets) is a function of the future revenue stream generated by the assets. That is, the asset value is not a function of the funds required to provide that asset. Alternatively, if charges seek to recover the costs of provision[147] then the value of that future revenue stream will be a function of the outlay needed to provide the assets. In this situation, the higher the value that an infrastructure manager can place on the asset's worth (based, perhaps, on a yardstick of historical or current value of the physical costs of the asset), the higher the access charges that can be levied and the higher their future revenue stream.

146 In Australia this formalisation takes the form of a access undertaking, a certified undertaking or a declaration of assets. See BTRE 2003 (p. 60 and Chapter 3 *passim*) for further discussion of these processes.

147 In practice, competition from other modes may inhibit price-setters' ability to charge at levels that recover long-run costs. In this situation, there will be inadequate return from the charges levied to enable self-funding to secure long-run provision of the infrastructure.

4.3 Australian access regimes: floor price definitions

Regime	*Floor*
NSW	**Required minimum for individual train services**. The charge is equivalent to the costs that vary with usage over 12-month period plus an estimate of the 'levellised' (smoothed) variable 'major periodic maintenance' activities (re-railing, rail grinding and resurfacing). It excludes depreciation costs. **Objective minimum** The access charge should be set so that revenue from all Access Seekers on a line sector (or group of sectors) should cover the incremental costs of providing the sector(s).
Queensland	Expected incremental cost-costs of providing access, including capital renewal and capital expansion costs-incurred over the life of the Access Agreement
South Australia	The floor price should reflect the lowest price at which the operator can provide the relevant services without incurring a loss. The floor will match the infrastructure manager's 'incremental' costs that would arise from providing the minimum services and facilities required to meet the applicant's specific needs. (ECOSA 2004, p. 13)
AustralAsia	Incremental cost, consisting of maintenance costs, capital consumption costs attributable to the individual service and some signalling costs. • maintenance costs of v cents per gross tonne kilometre (estimated from variable maintenance costs of $w million divided by x million gross tonne kilometres freight task); • capital consumption costs of y cents per gross tonne kilometre as the estimated depreciation charge; • interest charge of z cents per gross tonne kilometre.
WA	Incremental costs, comprising the operating costs, capital costs and overhead costs that would be avoided in the 12 months following the access: • Operating costs comprise train control costs, signalling and telecommunications, train scheduling, emergency maintenance, information reporting, maintenance costs of infrastructure averaged over the maintenance cycle, costs incurred if infrastructure was replaced using modern equivalent assets. • Capital costs comprise depreciation costs (using Gross Replacement Value) and risk-adjusted return on the relevant infrastructure (using the Weighted Average Cost of Capital)
Victoria	No floor price
ARTC	Floor price is equivalent to the incremental costs of the given line segment or group of segments. Costs are the costs avoided if the segment was removed from the network. Costs include segment-specific costs and non-Segment-specific costs relating to: • maintenance (track, signalling, communication) • costs of supervising maintenance contracts and project management • train control and communication • train planning and operations administration • system management and administration Costs exclude depreciation and return on segment-specific assets and non-segment-specific assets.

Sources: BTRE 2003, p. 75; Essential Services Commission of SA (2004, p. 13).

Thus, the asset valuation can be a somewhat arbitrary judgement and this affects the infrastructure charge. Consequently, where infrastructure charges incorporate asset valuations, it is possible for charges to vary according to the principles adopted by the infrastructure manager and/or regulator.

Cost measurement

In 2003, the BTRE published research on rail infrastructure pricing. One finding was that there is no distinct definition of the marginal cost of infrastructure use:

> Scherp reports that the rail regulatory committee, reporting to the EC, found that each EU Member State arrives at different figures for marginal cost. This, the committee concludes, is a function of differences in scope, definitions, unit costs, what is included in those costs and unit cost differences across States. Marginal cost figures diverge by a factor of 1 to 20. The committee concludes, nonetheless, that it is possible to calculate marginal cost by harmonising methodology (Scherp, pp. 4–5). We argue, however, that it is unlikely that this can be achieved: there is a trade-off between the level of investment in infrastructure/standard of infrastructure, the level of performance permitted (e.g., axle loads and train speeds) and the level of maintenance that is then required. (BTRE 2003, p. 51)

Given the level of judgement involved in marginal cost attribution, it is not surprising that there are different definitions of floor and ceiling prices in the different Australian access regimes. These definitions are outlined in Table 4.3 and Table 4.4, below.

There are two general conclusions. First, the infrastructure pricing diversity that we have identified is not necessarily one that should be harmonised. Charging levels and charging structures should not be identical across the system. Secondly, however, while definitions of costs and infrastructure usage can be ambiguous (and it is not surprising to find definitions varying across jurisdictions), a degree of consistency will benefit the industry. These benefits will include greater certainty over charges, a reduction in resources involved in disputing the various definitions and more consistent pricing signals; these issues are now considered.

4.4 Australian access regimes: ceiling price definitions

Regime	*Ceiling*
NSW	Access charges set to a level such that revenue must not exceed the stand-alone cost of a line sector; includes non-sector-specific overhead costs • Asset value based on Depreciated Optimised Replacement Cost (DORC) • Return on assets based on Weighted Average Cost of Capital (WACC) • Straight-line depreciation, based on original DORC value 94 percent of route km (i.e., the non-coal lines) have a nought asset value.
Queensland	'Revenue limit' based on stand-alone cost and including contribution to overheads • Asset value based on DORC • Return on assets • Based on efficient costs, including overheads Capital costs considered are those for the period of the Access Agreement
South Australia	This is the price that matches the full economic cost of the minimum services and facilities required, net of other actual or notional sources of access revenue. The sum of the prices paid by all users should not exceed the full economic cost of the minimum services and facilities required to meet the users' collective needs.
AustralAsia	The ceiling is the stand-alone cost • Asset value based on DORC • Return on assets with a risk premium (to be decided) • Depreciation, based on DORC • Recovery of efficient operating costs, including overhead costs and maintenance
WA	Ceiling based on the total costs of the relevant route and infrastructure • Asset value based on GRV (Gross Replacement Value) • Return on assets, adjusted for risk, based on WACC • Depreciation, based on GRV • Recovery of efficient operating costs and overheads Maintenance costs based on spread of costs over the maintenance cycle, calculated as an annual cost
Victoria	No regulatory band
ARTC	Access charge for a line sector are to generate revenue sufficient to cover the economic cost of the sector • Asset value based on DORC • Return on assets, based on WACC • Depreciation Non-sector costs are allocated on the basis of the access seeker's task and infrastructure usage—on gross tonne kilometres, track kilometres and train kilometres

Source: BTRE (2003, p. 77); Essential Services Commission of SA (2004, p. 14).

Duplication and harmonisation issues

In looking at the harmonisation aspects of multiple access regulation, the authors review two principal issues.

Regulatory impact

A consequence of multiple regulators is that firms implicitly face higher regulatory administration costs and potentially the costs of inferior regulation. In addition, train operators, in particular, face ambiguity in the application of access charges. Inconsistent access charging levels and structures, for railways with similar characteristics, will send conflicting messages to operators on how they run their services. They will also give divergent signals to infrastructure managers on investment strategies for otherwise contiguous railway corridors.

There are further issues of consistency. ARTC have argued that all industries 'whose operation has national implications' should be overseen by ACCC only. The corporation considers that a single access adjudicator within, and between, industries will facilitate:

- the application of a consistent set of competitive principles across all regimes;
- the provision of a more coherent framework for identifying markets; and
- setting a consistent framework for applying access principles across sectors—irrespective of the ownership of assets. (ARTC 2004a, p. 11)

To the extent that there is multiple regulation of participants, there is excessive regulation. Excessive and inconsistent access regulation will adversely affect the industry. The regulations are being applied to firms in an industry that, historically, has recorded substantial losses. Rail firms have very limited route-traffic. In addition, their potential to capture traffic from other modes, principally road, the new private railways are likely to face financial returns that are, at best, modest. Even the private sector railways in the United States, with far greater volumes of traffic, do not earn returns that could justify long-term re-investment in the system.[148] Consequently, given the low financial returns from most of Australian railways and, consequently, the poor incentives for them to invest in the longer term, we conclude that such marginal operations are particularly vulnerable to inappropriate and/or excessive regulations.

So, a primary impact of excessive and inconsistent regulations is to undermine railways' viability. That inconsistency can arise from within the regulatory activity or across regulatory activities—for example, where the regulation is imposed without recognising the industry's capability to absorb the changes. Thus there is a case for varying degrees of regulatory oversight. However, the industry would nonetheless face clearer pricing signals, and lower regulatory burden, if the number of regulatory interfaces was reduced.

Regulatory capability

Mandated access regulation is a new discipline worldwide—not just in Australia. Compared with other countries, however, Australia's application is particularly ambitious because it is being applied to privately-owned operations. Regulatory failure here could lead to a range of suboptimal outcomes—such as renationalisation—rather than just a higher subsidy to the public rail operator.

So regulatory capability is an essential part of access regulation. However, with multiple regulators, that capability is being diluted. In addition, it is generating inconsistent outcomes that adversely affect rail firms and the economic and investment signals that they face. It is also important to note that when firms are regulated they need to have the necessary interface to respond to the regulatory issues. On this issue, the World Bank has observed that:

> Most of the policy considerations relevant to assigning regulatory responsibilities among tiers of government are identical across countries, developed and developing alike. But, constrained regulatory capacity is especially important in many developing *and reforming*

148 Jackson (2004, p. 467) quotes the CEO of Burlington Northern Santa Fe as saying that the USA's biggest (Class I) railways earn a Return On Investment and Capital (ROIC) of around 6.6 percent while their cost of capital is around 2 to 3 percentage points higher. The CEO notes that a consequence is that while their capital investment programme is adequately funded, they cannot invest sufficiently to meet the higher forecasted traffic levels.

> countries. The principal concern is the relative scarcity (and high opportunity costs) of qualified regulatory personnel at decentralized tiers of government... (Smith and Shin 1995, p. 57) (emphasis added)

Thus, the multiple access regulation structure spreads the limited resources in regulation and the equivalent industry personnel required to respond to that regulation. Consequently, that regulation, and responses to it, is suboptimal.

Developments

In 2006, the Council of Australian Governments (COAG) signed a communiqué agreeing to the implementation of a consistent national system of rail access regulation. This system is to apply to 'agreed nationally significant railways', using ARTC's access undertaking as a model (COAG 2006).

Safety regulations

In this section we consider rail safety regulation.[149] There are three important aspects of railway safety oversight, and these are considered in the following text:

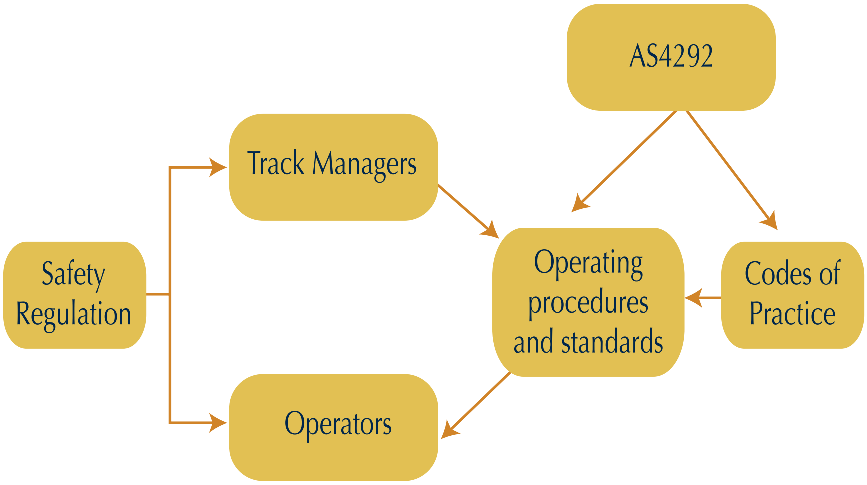
- **standard-setting** in technical systems and operational practices;
- **accreditation**—or licensing-systems; and
- **incident investigation**.

Figure 4.2 presents an overview of the safety regulation system. At the heart of the process are the operating procedures and standards. They are influenced by a government-based Australian Standard (AS 4292) and the industry-owned Code of Practice for technical and operational specifications. The code was discussed in the previous chapter. Note that, in Victoria, the PTC Rule Book is also a parameter in regulations and operating procedures and standards.

Safety regulators can set technical standards and operational practices that railway firms must abide by. They accredit track managers and

149 Note that the newly-formed safety regulators were initially termed 'accreditation authorities', albeit that their oversight extends beyond simply accrediting (licensing) industry players.

4.2 **Relationship of safety regulation (with accreditation), operating procedures, standards and Code of Practice**



Source: Accreditation Authorities (2001, p.27).

operators. Their suitability is assessed on criteria such as the comprehensiveness and robustness of their Safety Management Systems. These systems are designed to identify and manage risks. These standard-setting and accreditation issues are considered here.

We consider incident investigation separately. We note that, NSW and Victoria apart, the investigating entities are part of the safety regulatory authority; and that the findings of an incident investigation influence future safety strategy. Nonetheless we note that it is not clear-cut that investigation should be part of the safety regulation. In particular, there is a need to be assured that investigation is removed from efforts to hide any regulatory failure.

Rationale for safety regulators

Principles of external safety regulation

In recent years, railway safety regulation has evolved from a process that was largely internal to the industry, to an externally defined and enforced process. Until the 1990s, the roles of railway operator, safety regulator and incident investigator were management processes that were internal to the railway. (Intergovernmental Working Group on Rail Safety 1993, p. 5) Of course, here the railway task included infrastructure maintenance and management, and passenger and freight train operations under the one management.

The shift to external regulation occurred when other key railway policies—privatisation, corporatisation, structural and mandated access—were implemented. The reasons for this shift are not often or consistently articulated. Our presumption is that the policy changes require greater safety processes or greater government oversight. The implication is that the market fails to provide sufficient safety. Bray notes that:

> …there might be no need for regulation of safety if its costs and consequences were internalised to the railway industry and reflected in their commercial performance. If costs are internalised, and safety standards derived accordingly, the standards can be expected to be at about the level indicated by a benefit-cost ratio of one. (Bray 2005, p. 25)

The rationale for overturning a presumed benefit-cost ratio of one is rarely developed, and Bray concludes that:

> ...it appears to be accepted that market failure that results in consumers being unable to make fully informed decisions justifies regulation, and presumed that the benefits of regulation outweigh the risk of regulatory failure. (Bray 2005, p. 25)

In his review of the economics of railway safety, Savage considers reasons for market failure in safety—where railways provide a sub-optimal level of safety. Savage suggests three reasons that justify government safety regulation:

- customer irrationality—railways may be motivated to provide too little safety if customers ignore safety aspects in order to reduce their anxiety about unpleasant events;
- insurance premiums—Savage speculates that insurance companies are not motivated to monitor the accident prevention actions of inexperienced firms. Consequently, those firms will not be motivated to make the correct trade-off between prevention efforts and future accident costs. Government would set the appropriate standard so that inexperienced firms do not act myopically (Savage 1998, p. 137); and

- prevention of cheating—firms may be tempted to offer services with lower quality, safety, services, especially if they are 'financially-distressed' (Savage 1998, p. 137).

In addition, Savage identifies a separate grouping of safety issues where market failure is possible. This is the case with 'bilateral accidents', such as level crossing and trespassing accidents, where the railway and the other party can affect the probability of an accident occurring. Savage argues that '…there is a high likelihood of market failure in those cases where the consequences of one party's actions impose substantial accident costs on the other party' (Savage 1998, p. 50).

In 1994, Transport Canada reviewed Canada's railway safety and concluded that its railways placed a great emphasis on safety. Despite this, the authors were concerned about these bilateral interfaces, where '…the railways have less control and where the dangers have been demonstrated to be of greater consequence' (Transport Canada 1994).

Having argued a case for public intervention in rail safety, Savage then identified five rail safety regulatory tasks (1998, pp. 139–40). These are:

- the tasks related to other policy responses to safety regulation, such as incident reporting and investigation;
- minimising externalities, for example, carriage of hazardous materials;
- civil liberties, for example, drugs and alcohol;
- specifications for equipment design and for operating practices; and
- monitoring and enforcement.

Savage argues that safety regulations can only be classed as 'successful' if they satisfy three criteria. First, the regulations generally must address market failure. His second criterion is that the prescribed standards are set at appropriate levels to achieve the minimum acceptable benchmark safety level. Finally, in Savage's view, compliance with the monitoring and enforcement strategies must be achieved at minimum cost to both government and regulated firms. (Savage 1998, p. 149)

This shift from internal management, or regulation, of safety, to an externally-imposed regulatory framework must be set against the overall risk involved in any regulation. Two notable risks in safety regulation are:

- **Impact on efficiency**. In general, regulation can impede firms' efficiency; the Institute for Transport Studies reviewed studies of railway efficiency, noting that 'railways with more freedom or less regulatory control from the government have a higher degree of efficiency' (ITS, quoted in CER 2004, p. 42).
- **Skewed incentive to optimise safety**. Prof. Andrew Evans notes that safety regulators can require a higher safety standard than is economically efficient when they, the regulators, do not pay the penalty for excessive safety zeal but bear a cost in the event of an accident (Evans 1994, p. 6).

Safety regulation following policy changes

While acknowledging that there are public welfare issues in railway safety, Australian, and many overseas, railways have usually *self*-regulated many of their safety activities.

What has led to the recent shift away from this self-management and monitoring of safety, to a system of external safety regulation by each jurisdiction? Changes in external policy and the number of industry interfaces have precipitated the move to external safety regulation.

Diverse policy changes

An important rationale for the shift to external safety regulation arises through external policy shifts. The Northern Territory argues that:

> With the commercialisation in the 90s of the railway industry, it was not possible to retain the previous system of rail safety regulation', suggesting that the third-party access, contracting out and increased cross-border movements flowed from this commercialisation. (NT Department of Infrastructure, Planning and Environment, undated).[150]

150 It might be argued here that freight operators certainly have the incentive to optimise safety. When safety is compromised, freight operators invariably risk damage to their own equipment, reliability and punctuality and, given the long length of most freight trains, a safety incident will impact on a vast number of immediate and downstream customers. This does not mean that the industry does not require regulatory oversight-some might argue that oversight is required to prevent firms 'cutting corners' to gain a cost competitive edge over rivals. Privately-owned passenger train operators arguably have the same commercial incentives as airlines to ensure a high standard of safety. State-run passenger operators have a long tradition of safe operations, typically with strong political incentives. Savage (1998, p. 98 and Chapters 12-16, passim) considers possible market failures that might lead to sub-optimal safety.

Just what practical effect that commercialisation has on safety is not elaborated but Deen argues that:

> At some level, any private carrier must maintain its equipment and operate in a safe manner to attract customers and minimize the cost of crashes. However, short-term financial pressures sometimes influence decisions, and safety regulation is generally accepted as a necessary intervention. (Deen 2003, p. 18)

NERA argues, however, that commercial pressures can be a powerful reinforcement to safety regulation. It highlights evidence that the stronger commercial pressure arising from privatisation *increased* rather than decreased safety. (NERA 2000, p. 98)

Industry interfaces

The second rationale for the shift to external safety regulation arises from the number and dispersal of industry players. Two important aspects of this are vertical separation and third-party firms using or maintaining the track. As discussed in Chapter 2, these new interfaces potentially increase railway risks and so more formal safety processes need to be in place to manage risk.[151] [152]

Rail reforms have expanded the number of industry players on a given railway and thus the 'added need to regulate the interfaces' between these multiple players (BAH 1999, p. III–13). As suggested by Booz

151 In 2004, the NSW Government re-integrated its urban infrastructure and passenger train operations (forming RailCorp) on the basis that 'Experience with vertical separation of agencies both in NSW and internationally is that the splitting of functions across separate organisations reduces communication, spreads scarce technical expertise and leads to ambiguities in accountabilities and responsibilities. Justice McInerney also highlighted this point in his report into the Glenbrook accident'. (NSW Parliament 2003, Hansard p. 5557) Research in Great Britain points to a lower level of human resources needed for the segment of British Rail that has remained vertically-integrated (on the Isle of Wight) relative to the vertically-separated infrastructure (Transport Research and Information Network, p. 16).

152 The consequences for safety in not ensuring the efficacy of those additional processes was an important factor that sustained the unnecessarily high risk of the human error that led to the Ladbroke Grove accident in London in 1999. As Leach (2002, p. 24) notes 'Professor John Hibbs, in reference to the failure of communication that was part and parcel of the crash, refers to the so-called "cloud on the mountain" problem. Information between Railtrack [Infrastructure Manager] and Tocs [Train Operating Companies] needs to be passed up and across and back down again, whereas prior to privatisation, the information would merely have been transferred horizontally. In the up and across and down model, the information may get stuck, lost or altered in the process'.

Allen Hamilton, it could be argued that the industry needed to move from safety self-regulation:

> It is now well accepted that self-regulation is not feasible in an environment of multiple industry participants, though some larger organisations make a case that the regime adds little, if anything, to their specific safety performance... [despite] the adjustment that some of the traditional railways have had to make to gain accreditation. (BAH 1999, p. III–12)

The traditional integrated railway undertook an extensive and/or comprehensive range of activities. Mandated access regulation and extensive outsourcing have meant that, for much of the rail network, these railways have evolved into separate entities for train operation and infrastructure management. Train operators often outsource rolling stock maintenance and infrastructure managers buy in many of their activities—including core activities such as track maintenance and renewal.[153] [154] More significantly, processes are required to manage the new interfaces arising from multiple train operators sharing a given railway network.[155] In considering whether to recommend mandated access to infrastructure, the Canada Transportation Act Review Panel noted that:

> ...co-ordinating two (or more) railway operations on a single line raises safety concerns that do not exist on a line with a single operator. (Canada Transportation Act Review Panel 2001, p. 88)

This issue has grown in Australia with the advent of mandated access. The issue is also more important due to the polarisation of industry management and task into the urban passenger 'islands' (as discussed

153 Even where train and track share common ownership, such as with QR, the activities are organised to a large extent as separate entities.

154 It should be noted that the NSW Rail Safety Act 1993 predates the National Competition Policy that formalised and mandated the process of third-party and open access to track infrastructure. McInerney (2001, p. 26) interprets the initiative for the 1993 Act as deriving from, first, the 'government policy' to separate regulatory powers from operational agencies (i.e., the then State Rail Authority); and, secondly, the reaction to an accident at Cowan in 1990, where an SRA train collided with the rear of a heritage train that was staffed primarily by volunteers.

155 The Intergovernmental Working Group on Rail Safety puts the emergence of multiple operators as one of the 'major factors' supporting the case for changing rail safety arrangements; others include the creation of National Rail and the development of single corridor passenger arrangements by Australian National and NSW's State Rail Authority (requiring common safety arrangements) (p. 8).

in Chapter 1) and interstate freight linking *and passing through* those passenger islands.

A consequence of the increase in industry players is that:

> ...the risk profile presented is substantially greater than with integrated, single manager operations. (Booz Allen Hamilton 1999, p. II–11)

Thus, it seems that commercialisation and increased interfaces—from outsourcing, mandated access and vertical separation—have led to formal external safety regulation processes. We should note, though, that this outcome is not the only approach for managing these interfaces. For instance, the European Transport Safety Council notes that in Europe:

> The general approach when separating railway activities has been to allocate general responsibility for the safe operation of railways to the track authorities... [who] must not only ensure that their own track and signalling systems are safe, but are also often required to check the safety competence of any train operator who wishes to use their systems. (European Transport Safety Council 1999, para. 3)

In principle, safety regulators bring with them the remit to oversee the capabilities of the multi-user/multi-supplier railway and regulate the processes that manage the interfaces between the industry players.

Increasing the number of interfaces increases the risk profile. We should note therefore that in applying this regulatory oversight for each jurisdiction in Australia, the regulators multiply the number of these interfaces. Each State, and the Northern Territory, has a rail safety regulatory function—see Table 4.5.

The ARA regards the current safety system as being sub-optimal. It observes that:

- Different states and territories have different safety legislation;
- Different states and territories have different philosophies, ranging from less prescriptive to more prescriptive; and
- Different states and territories interpret regulations in unique ways.(ARA web site).

This number of interfaces is particularly relevant when inconsistencies in principle and application arise. In the context of information and communication flows, the number of interfaces is an important safety parameter and possible regulatory drag. Thus, for example, when the British government overhauled its railway industry in 2004, it focused on rationalising its regulatory system. The government

4.5 Rail safety regulators and incident investigation

Jurisdiction	*Safety regulator †*	*Legislation*	*Infrastructure includes*:*
New South Wales	NSW Transport Safety and Rail Safety Regulator The Office of Transport Safety Investigations	Rail Safety Act 2002; NSW Transport Legislation Amendment (Safety and Reliability) Act Amendments to Transport Administration Act 1988	NSW standard gauge (west to Broken Hill) —Rail Infrastructure Corporation
Queensland	Rail Safety Accreditation Unit, Land Transport & Safety Division, Queensland Transport	Transport Infrastructure Act 1994	*Queensland standard and narrow gauge— QR Network Access*
South Australia	Rail Operations and Safety, Transport SA	Rail Safety Act 1996	SA broad, standard and narrow gauge track (west to Kalgoorlie; east to Wolseley, Broken Hill)-Genesee & Wyoming track, ARTC track, TransAdelaide track, NRG Flinders Power track, Onesteel's Iron Duke line.
Victoria	Public Transport Safety Directorate, Department of Infrastructure Office of Chief Investigator, Transport and Marine Safety Investigations	Transport (Rail Safety) Act 1996; Rail Safety Bill 2005 Transport Legislation (Safety Investigations Bill) 2005	Pacific National standard and broad gauge track; Metlink; ARTC standard gauge west to Wolseley; southern NSW broad gauge
Western Australia	Office of Rail Safety, Department of Transport	Rail Safety Act 1998	WestNet standard and narrow gauge east to Kalgoorlie; Transperth, Pilbara Rail
Tasmania	Tasmania Rail Safety Regulator	Rail Safety Act 1997	Pacific National Tasmania
Northern Territory	Department of Transport and Works	NT Rail Safety Act 1998	SA border to Darwin

• In addition, heritage lines are subject to the Acts of the jurisdictions in which they operate.

** Some private mining railways come under relevant jurisdictions' Mining Acts-for example, BHP-Billiton's Pilbara railways.

† Apart from NSW and Victoria, the safety regulator's role includes that of incident investigation; in NSW the independent rail incident investigatory body is The Office of Transport Safety Investigations, a multi-modal (rail, maritime and road) investigatory body. The Transport Legislation (Safety Investigations Bill) 2005 establishes the Office of Chief Investigator, Transport and Marine Safety Investigations.

expressed concern that it was the '…current industry [that] too often hinders progress' and argued that:

> It is not the individual elements of the privatised railway that are the most problematic. It is the complex interfaces between them that are at the root of its difficulties. (Department for Transport 2004, p. 17)

Safety monitoring and incident investigation

Safety monitoring and incident investigation are undertaken on a State/Territory jurisdictional basis. The Australian Government's Australian Transport Safety Bureau (ATSB) separately conducts independent, no-blame investigations on the Defined Interstate Rail Network (DIRN); the ATSB is an incident investigator and is *not* a safety regulator. It is important to see the role of safety regulatory oversight as a different task from that of technical investigations of safety incidents/accidents—although both regulation and investigation are integral to overall safety oversight. Indeed, the safety regulator may conduct its own incident investigation to establish compliance with conditions of accreditation or to prosecute for breaches of regulations.[156]

Nonetheless, although the regulatory and investigation roles are linked, it can be argued that unbiased, open and transparent investigations require that the investigating authority be independent of the safety regulator.[157]

The Australian approach has three features that are relevant to this study:

- **Separation of roles.** NSW and Victoria have acted on the need to ensure the independence in the role of incident investigation (as already applies to ATSB) from the safety regulation role.[158]

156 The Memoranda of Understanding between the ATSB and the rail safety regulators recognises their separate roles but also their joint interest in improving rail safety.

157 It may be argued that full recognition of regulatory failure is less likely when the investigation of a safety incident undertaken by a safety regulator identifies safety regulatory deficiencies. In this context we note the adoption of this principle in other countries and modes. For instance, the Civil Aviation Safety Authority and the Australian Transport Safety Bureau respectively oversee safety regulation and incident investigation independently, albeit with a constructive working relationship between the two independent organisations—see ATSB 2004. The application of this approach to rail incidents in NSW was advocated by Peter McInerney QC, in his final report of the special commission of inquiry into the Waterfall rail accident (McInerney 2005, p. 206)—repeating his earlier recommendation made in the Glenbrook inquiry (McInerney 2001).

158 The Office of Transport Safety Investigations (in NSW) was established in 2005 while the Office of Chief Investigator, Transport and Marine Safety Investigations (in Victoria) will be formed following the passing of enabling legislation.

Elsewhere these roles are under the same umbrella—safety regulators are responsible for incident investigation.

- **Consistency in external investigation.** Australian Standard AS 4292.7, *Rail safety investigations*, is intended to provide a common approach to incident investigation. However, there is no legal requirement for compliance so approaches are not necessarily consistent.
- **Consistency in internal investigation.** Accredited rail organisations investigate incidents in accordance with Australian Standard AS 4292.7. In 2005, the ARA's Code Management Company published a draft Australian Rail Investigation Code of Practice, to help rail organisations comply with this Standard. (ARA 2005)

Efforts have been made to bring about greater consistency. The *Transport Safety Investigation Act 2003* enables the ATSB to undertake independent and no-blame investigations. The ATSB's role is to investigate and to recommend—it is *not* a regulatory authority and is completely separate from any such authority.

The ATSB's powers might be interpreted as complementing those of State/Territory safety regulators. In this context, it 'is only concerned with future safety' (Ibid.). Where State authorities invite the bureau to investigate incidents beyond the interstate network—that is, on intrastate lines—'such investigations [have been undertaken] under legislation in the state with jurisdiction' (Ibid., p. 7). For instance, the Queensland Government invited the ATSB to be the 'lead agency involved in undertaking a full and joint independent accident investigation in conjunction with Queensland Transport' under the legal framework of Queensland's *Transport Infrastructure Act 1994* (ATSB 2005a, p. vii). However, in the interests of assuring its independence, the ATSB has advised State and Territory jurisdictions that, in the future, if it is invited to condut a non-DIRN investigation, it would only do so under the provisions of the *Transport Safety Investigation Act*.

Where an incident involves a fatality, a coroner may also inquire into the cause of death. Where such investigations arise, the 'coronial investigation and the ATSB investigation are complementary' (Ibid.).

It should also be noted that the relevant jurisdiction's OH&S inspectors are also likely to be involved in the investigation of a safety incident. This is an inevitable consequence of the division of safety responsibility. In Victoria, the DOI notes that the OH&S inspectors' powers 'are primarily aimed at ascertaining whether or not an offence has been committed under the OHS Act and whether prosecution should be taken' (DOI 2004, p. 26).

The State-based approach to incident investigation has consequences for learning from incidents. An important aspect of investigation is to identify and to learn from the incident. Potentially, these are system-wide rather than localised lessons. By limiting oversight at the local level, lessons are less likely to be disseminated and understood. Current regulatory structures are jurisdiction-based and the rail industries in each jurisdiction are relatively small. This makes it more difficult to justify the arguably-superior structure that has separate entities for regulation and investigation.

If a national investigation structure replaced the jurisdiction/safety-regulator-based structure, it would remove the duplication and the inconsistencies in the way that monitoring and incidents are treated.[159] For example, inconsistencies remain with safety statistics. Three different data bases are maintained: systems for NSW, for Queensland and the other jurisdictions. Although common data definitions are now being applied, the definitions are not being applied consistently. It is notable that the United States' railways recognised this issue almost century ago:

> Although the railroad industry in general was not in favour of reporting requirements, they did desire a standardized system of accident reporting rather than being forced to attempt to deal with a patch work of state laws on the subject. [In response, therefore] On May 6, 1910, the Congress enacted the Accident Reports Act of 1910. (McDonald 1993, p. 15)

In addition to data problems arising from pursuing parallel tasks, problems remain with investigation. Duplicated investigations may blur the process of diffusing the lessons and consequences of accidents and the lessons to be learned from those incidents.[160]

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159 Industry players acknowledge that there is a 'lack of consistency of inspections'. (NTC Workshop 16 June 2004)

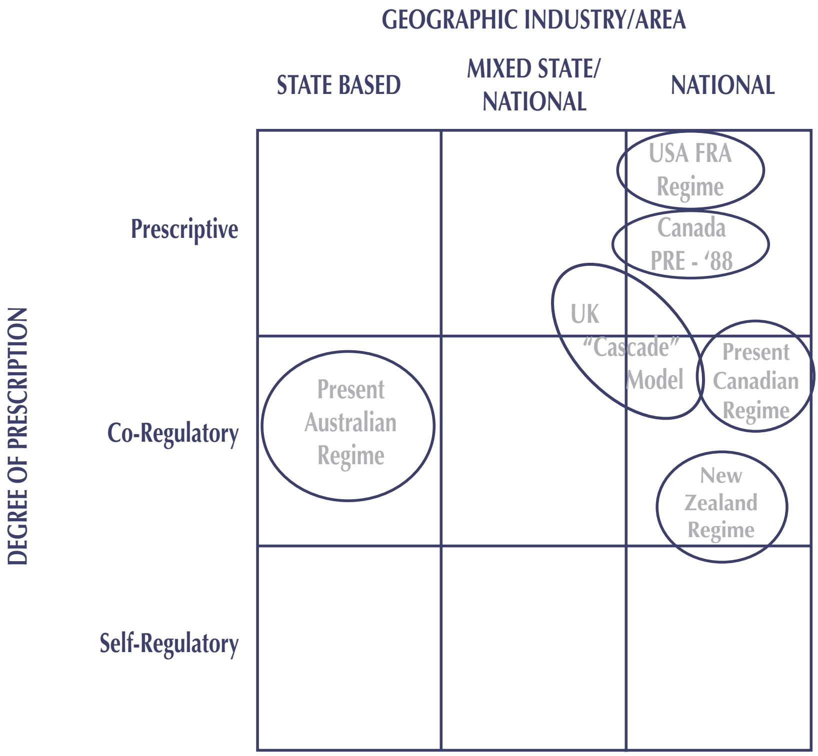
160 The experiences with duplicated rail accreditation can be compared with that of aviation safety regulation. At the Premiers' Conference in 1920, the States agreed to refer control of air navigation to the Commonwealth Government. However, only Tasmania actually transferred control. It took until 1965 when, following litigation, the High Court held that Commonwealth Law was concerned with safety, regularity and efficiency (in a technical sense) of air navigation. Consequently, safety-orientated regulations are the responsibility of the Commonwealth (BTE 1980, pp. 18–21).

Safety regulation model

The industry has therefore moved away from a system based on railways' self-regulation, or oversight, of safety. One model that could have been adopted would have been to fully-prescribe safety systems. In this model, the risk-makers are required to comply with systems set by the regulator (AAG 2001, p. 30). As illustrated in Figure 4.3, the model adopted in Australia is less prescriptive than that used in Britain and North America and is State-based rather than national.

Under co-regulation, the risk-takers—the railway industry players—propose safety systems. They must be able to demonstrate to a safety regulator that such system are fit-for-purpose and meet standards

4.3 **The basis of railway safety regulation in Australia and overseas**[a]



a Excludes some major privately-built mineral railways, which are regulated by mining acts.

Source: Booz Allen Hamilton (1999, p.II-15).

specified by that regulator. By implication, if standards are prescribed but are safety deficient for a given circumstance, then the risk arguably lies with the prescribing authority rather than the rail entity.

Co-regulation is a combination of self-regulation and prescribed government regulation and involves some discretion in the regulatory process. Under this system:

> Going back to first principles in co-regulation the accountability and responsibility for managing risk and mitigating risk is carried by the organisation that creates the risk. (ARSAA 2001, p. 29)

Consequently, the procedures are flexible and the details are determined by the infrastructure managers. The Australian Rail Safety Accreditation Authorities (ARSAA) comment that:

> This approach however can and does result in railway managers (access providers) determining different standards and safeworking rules (regulations) for the infrastructure which they control. ***As a result of this operators who run trains over different managers tracks find that they have various safeworking rules to which they must comply.***
> … under the current approach of non-prescriptive regulation this situation is one over which accreditation authorities have little or no control. (emphasis added) (ARSAA 1999, p. 2)

Booz Allen Hamilton defines co-regulation as being that, '…for practical purposes the industry is regulated jointly by the industry and government, a process designed to apply external safeguards to an otherwise self regulated industry' (BAH 1999, p. II–15).

As it has evolved, this co-regulated safety system can be considered to consist of a number of processes: accreditation of industry players and of physical assets, operational procedures and rules, certification of workers, and safety monitoring and investigation. The processes are applied as follows:

- accreditation of organisations:
    - infrastructure managers;
    - train operators;
    - maintainers, manufacturers and constructors of rail assets;

- accreditation of physical assets:
  - operating equipment;
  - infrastructure assets;
- accreditation of processes:
  - operating rules and procedures;
  - risk management systems;
- operational procedures
  - rules and procedures related to railway operations, such as incident reporting;
- rules for control of train movements;
- certification of labour force:
  - train drivers, track workers, signallers etc; and
- safety monitoring and incident investigation. (Safeworking Services 1999, p. 2 and Affleck 2003, p. 20)

Certification of the labour force can be (but is not) undertaken by the safety regulator. The DOI notes that the Victorian Safety Regulator takes the view that accreditation or licensing of safety critical workers (such as drivers and signallers) is '…well outside the scope of [the rail safety regulator's] role' (DOI 2004, p. 68). Alternatively, the regulator may accredit an organisation to undertake training and certification. These processes were also influenced by the setting of the Australian Standard on Rail Safety Management (AS 4292) and industry codes of practice.

Trends in safety regulations

In 1993, in accord with objectives to improve interoperability and access, the Australian Transport Council endorsed the report, *A national approach to rail safety regulation*. This report recommended that an inter-governmental agreement be established between the governments to achieve consistency in rail safety regulation. Consequently, in 1996, the States/Northern Territory and the

Commonwealth signed the Inter-Governmental Agreement (IGA) on Rail Safety.[161]

The co-regulation model followed from this agreement. The agreement set the co-regulation processes to be followed by accreditation seekers and jurisdictions; and the principles of mutual recognition—that is, recognition of accreditation across jurisdictions.[162] Each jurisdiction has adopted co-regulation and authorities acknowledged the principle that, where appropriate, the regulations need to be consistent.

In 2005 the principle of the co-regulatory approach was taken a stage further when the Australian transport ministers agreed to the principle of National Rail Safety Legislation. The intention is that national safety legislation would be enacted by each State government.[163]

It remains to be seen whether this strengthening of the co-regulatory framework will achieve convergence—something that has hitherto not occurred. However, arguably, unilateral safety regulations and the level of prescription in different jurisdictions cause regulations and safety principles to diverge rather than converge.

Despite the 1996 IGA on rail safety and the 1999 IGA on rail operational uniformity, jurisdictional safety regulators have continued to develop safety regulations on a unilateral basis. This trend has created more, rather than fewer, inconsistencies in regulations across jurisdictions.

161 In the context of railway reforms, this IGA might be interpreted as complementing the subsequent (1999) Inter-Governmental Agreement on Rail Operational Uniformity and the 2003 Intergovernmental Agreement for Regulatory and Operational Reform in Road, Rail and Intermodal Transport.

162 By way of illustration of mutual recognition, in 2004 there were 30 'commercial' companies accredited under the Victorian rail safety regime; of these, 13 were accredited through mutual recognition, including ARTC, Pacific National and the rolling stock manufacturer United Goninan (Auditor General Victoria 2005, pp. 91-92).

163 This agreement followed work and industry consultation undertaken by the NTC-see NTC 2004b.

This trend is partially attributable to local responses to safety incidents.[164] Regulatory responses to the Glenbrook, Waterfall and Port Botany[165] accidents in NSW included regulators making unilateral decisions. Similarly, the Victorian government, with the Australasian Railway Association, continues to develop the 'PTC book of rules and operating procedures' of train operator rules and practices.[166] (Track managers are required to comply with the PTC Rule Book as a condition for access to their network. (DOI 2004, p. 62)) A further illustration here relates to rail workers' health standards. On 1 July 2004, uniform national health standards for rail safety workers were introduced. This came *after* Victoria and NSW had introduced their own health assessment standards. The introduction of uniform standards followed Federal, State and Territory transport ministers' approval of the *Standard for Health Assessment of Rail Safety Workers*. It was developed through the National Transport Commission.

Some jurisdictions have moved towards a more prescriptive approach and away from co-regulation. The guiding principle of co-regulation is that in the first instance, train operators are responsible for the operating rules and regulations. This is a requirement of their Safety Management System. It is also a reflection of where the ability to influence the risk resides. Regulators may favour prescriptive regulation, however, because:

> ...it gives them something concrete to work with. On the other hand, performance-oriented standards encourage industry and regulatory flexibility. (Federal-Provincial Working Group on Rail Safety Regulation 2001, p. 28)

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164 The Victorian DOI has commented that 'In the main, rail safety regulation has evolved piecemeal, in response to the recommendations of accident investigation reports'. (DOI 2004, p. 11)

165 In the June 2004 Port Botany accident, a rail worker was fatally injured after falling while walking across the top of moving flat wagons. In response to this, the NSW regulator banned riding on wagon tops, wagon side-steps, wagon end-steps and locomotive steps. (Previously, these actions were implicitly condoned by an operator's rules and operating practices-or explicitly prohibited by those rules and practices.)

166 The Book of Rules is being revised to reflect/be consistent with the Code of Practice. The Book '...is an industry code which contains the operating rules and safeworking procedures for maintaining train separation on the suburban, regional and interstate networks. Its scope incudes signalling type and principles, train control, and safeworking systems'. (DOI 2004, p. 63)

In this context, to the extent that the Victorian safety regulator prescribes, by maintaining overall responsibility for the PTC Rule Book (and/or requires elements of the PTC Rule Book to be mandatory), it means there is the potential for the risks associated with the robustness and appropriateness of the operating rules and practices to reside with the regulator rather than the operator (as is the case in other jurisdictions).

We should also note that the co-regulatory model in itself increases the potential for inconsistencies because the boundary between self-regulation and prescription cannot be clearly defined. This is because there is some regulatory discretion that arises when adopting a half-way house between self-regulation and a full prescribed system.

It could be argued that prescription enables accreditation authorities to improve consistency in application and interpretation across the jurisdictions. There are two problems with this trend, however:

- As the PTC Rule Book example above, illustrates, the prescription can occur unilaterally and without a national consultation process.
- Prescription is used to bring about greater consistency across jurisdictions. However, in observing the trend towards greater prescription, Maunsell saw the potential problem that it would shift the responsibility for safety from the industry party to the standard setter (Maunsell 1998, p. 87). This goes against the principle that the industry player who is best placed to influence safety outcomes should also take responsibility for managing that risk.

Further the NTC comments that prescription can also reduce flexibility in operations and make accreditation harder to achieve:

> In 1993, there was evidence to suggest that prescriptive rules that had developed over time [by railway operators] were acting to impede the portability of equipment between jurisdictions:...*Flat wagons: the limiting of the AQCX container flat wagons to 80km/h is exclusive to one system; 3pack wagons: These wagons belonging to one system are banned by another outside that system despite having passed ROA performance standards*. (NTC 2004b, p. 39).

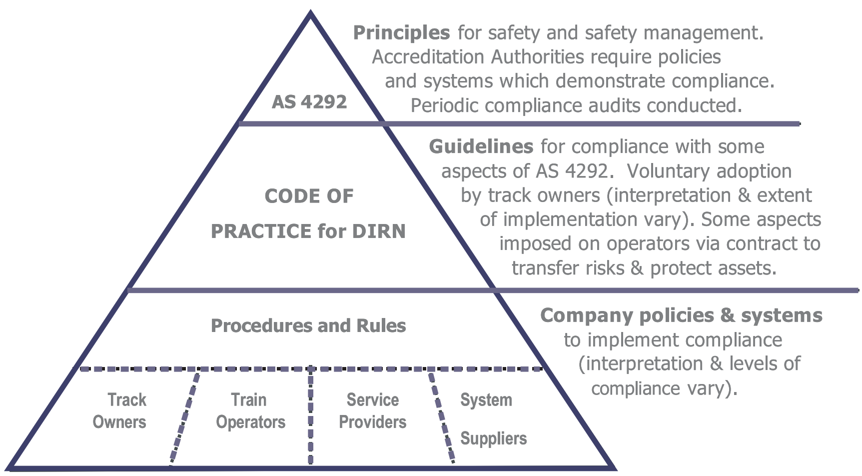
In summary, then, regulatory inconsistencies have arisen despite the stipulation of the safety and interoperability IGAs. In principle, these inconsistencies are, in themselves, potential safety issues for operators to the extent they require firms to operate in different ways in different jurisdictions. Given these trends, once the regulations are in place, it is also then more difficult to achieve consensus on applying them in other jurisdictions.

Industry-specific operational regulations and practices

In this section we review the various components of industry-specific safety-based operational regulations and practices. The following section considers the cross-industry regulations.

Affleck (2003, p. 20) provides an overview of rail operational management systems and how the different safety processes and systems relate to each other—see Figure 4.4. In this context, the different systems can be seen to complement each other; the further down the system, the greater the detail and specification. Further, as Affleck (2003, p. 17) notes, the system '…gives rail owners and operators substantial flexibility to establish risk management systems suited to the scale and nature of their operations and market'.

4.4 **Rail safety management systems**



Note: The Code can also be adopted by train operators.
Source: Affleck (2003, p. 20).

This diagram should not be interpreted as being comprehensive, however. It excludes the Victorian Government's Code of Practice.[167] It also excludes Victoria's railway working rules (the PTC Rule Book), which is being updated by the Victorian Government under the Victorian Network Rules Development and National Code of Practice Alignment Project. This contrasts with other jurisdictions, where there is only the approved code of practice for the interstate network and company-based operating—that is, safeworking—rules.

In the following section we discuss the individual elements of this system.

Australian standard on rail safety management (AS 4292)

There has been progress in establishing a consistent framework across jurisdictions for rail safety management. Since 1995, government and industry have worked with Standards Australia to produce an industry standard—the *Australian Railway Safety Standard, AS 4292*. These standards are performance-based and are non-prescriptive. Here, the process is to specify the output performance rather than an input standard. They are intended to be uniform across operations, thereby facilitating interface between industry players. Where a firm has conformed to AS/NZS ISO 9001—in relation to a Quality Management System—the relevant Quality Manual can be used to demonstrate compliance with the requirements of AS 4292.1.

Given the flexibility involved here, however, the jurisdiction-based regulation can lead to different approaches for identical risk environments.

Accreditation

Accreditation is a form of licensing that encompasses services such as infrastructure management, access provision, train operation, infrastructure maintenance and vehicle construction. For example, in NSW there were 70 accredited entities, as at October 2005, including:

- train operators, such as Lachlan Valley Rail Freight;

167 See, for instance, the code of practice for health assessment and certification for rail safety workers-draft version issued by the Department of Infrastructure.

- infrastructure managers, such as Pacific National[168] RailCorp and ARTC;
- vehicle construction firms, such as Evans Deakin Industries, Goninan, ABB, Bradken Rail and Alstom;
- infrastructure maintenance firms such as John Holland and Speno;
- heritage railways such as the Cooma–Monaro Railway and the NSW Rail Transport Museum; and
- downstream freight customers such as Mt Owen Mine and Port Waratah Coal Services.

Accreditation has two key components. First, there is accreditation of organisations (such as infrastructure managers, train operators and infrastructure contractors). Secondly, there are certifications of competency of operational staff.

Both infrastructure managers and train operators need to be accredited before managing rail infrastructure and/or operating trains on that infrastructure. Thus, for instance, the national train operator, Pacific National, is accredited in six jurisdictions. The firm seeking accreditation may adopt standards or codes of practice that are produced by other organisations.[169] It is up to the firm to determine the appropriate standards and to demonstrate to the accrediting authority that those standards are appropriate for its operations. The firm is liable for the standards or codes working, even if it has not written those terms and despite its endorsement by the accrediting authority (AAG 2001, p. 28).

Once a safety regulator has approved a train or railway operator's Safety Management Plan, then the organisation becomes an accredited operator, owner or owner/operator in that jurisdiction. For more information see the guidelines of the NSW Transport Safety and Rail Safety Regulator (2003).

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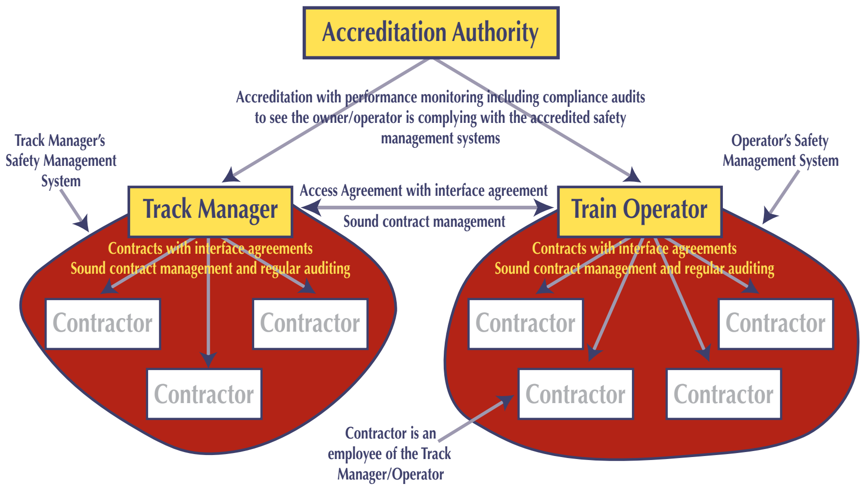
168 Pacific National manages some standard-gauge infrastructure. Further, from taking over Freight Australia it has inherited management of NSW railways built in broad gauge and connected to the Victorian broad gauge network. These lines fall under the NSW accreditation jurisdiction and are subject to the Border Railways Act 1922. (<http://www.austlii.edu.au/au/legis/nsw/consol_act/bra1922177/>)

169 For instance, the now-defunct Railways of Australia (ROA) produced standards, themselves based on Association of American Railroads (AAR) standards.

Figure 4.5 illustrates the link between the accrediting authority and the industry players. Here, the track manager and train operator are responsible for managing safety risks within their respective tasks. Contractors are covered by the safety systems of the manager or operator for whom they are working. The relationships between the various parties is then formalised with interface agreements that set out how the respective parties will interact in a range of different situations.

4.5 Outline of the co-regulatory model



Track Manager is responsible for managing the risk created by its total operation. The Operator is responsible for managing the risk created by its total operation. The safety responsibility of the Track Manager/Operator cannot be contracted away. This means they must have a safety mangement system that embraces their own operation and the operation of their contractors. The safety management system must include suitable forms of contact and appropriate contract management including auditing by the Track Manager/Operator, and interface agreements which explain safety arrangements.

Source: Accreditation Authorities Group (2001, p. 4).

To ensure consistency, AS 4292 forms the basis of the legislation that underpins the States' accreditation systems. The accreditation process is also guided by AS 4360, the Risk Management, standard. The ARSAA states that 'All accreditation authorities have agreed on a set of common processes and to apply them consistently' (ARSAA, p. 7). Nonetheless, ARSAA notes that differences in operating environments make it inappropriate to develop a universal accreditation system.[170] Given that most rail operations are intrastate or locally-based, ARSAA argues that a:

> ...local operator may have a simple task... [but will nonetheless be] required to establish his credentials to operate over all the territory in Australia, when he may have no intention of doing so. (ARSAA 1999, p. 5)

In addition, it can be argued—as we have done in earlier chapters—that customised solutions can be more effective and efficient than standardised solutions. This is especially so where standard outcomes are not required or appropriate.

Nonetheless, it seems appropriate that each jurisdiction should at least follow common principles. In addition, common approaches should occur in like-situations, irrespective of which jurisdiction a firm is operating in.

However, this is not evident. For example, the 2004 review of the rail safety regulatory framework in Victoria illustrates differences in philosophy. The review proposes the replacement of an SMS system in Victoria with the requirement that an organisation should prepare a Safety Case. The Safety Case would be greater than an acknowledgment of risks and a management of risks; it would involve the organisation making a case to the regulator and proving that safety risks are understood, controlled and acceptable (DOI 2004, p. 33). A consequence of the philosophical change would be a shift to greater regulatory oversight. The adoption of the Safety Case approach would lead to

> ...a more active role for the Safety Regulator which would impact on the relative accountabilities of the rail organisation and the Safety Regulator. (DOI 2004, p. 53)

170 This argument is made in mutual recognition schemes generally-that 'local conditions' require local terms. The Productivity Commission comments (in the context of terms for movement of hazardous goods): 'A more centralised approach could lead to situations where either safety is compromised in some jurisdictions or stricter conditions are imposed than warranted in others. There is also a risk that decision makers at a national level will not be aware of pertinent local conditions'. (Productivity Commission 2003a, p. 188)

Another example of difference in philosophy arises in NSW. In that State, industry suppliers, such as rolling stock manufacturers, are required to be accredited for that manufacturing task. In other jurisdictions, it is the rolling stock user—the train operator—who is accredited. Irrespective of which approach is 'best', nonetheless there is no apparent reason why the *local* NSW environment should require separate accreditation of suppliers—importantly, then, we note that the difference reflects a philosophical interpretation by the jurisdiction on the best way to apportion risk/risk management.[171] The NSW safety regulator notes that the Safety Management Systems (SMS) approach requires that elements of the contractor's SMS must be incorporated within the accredited operator's SMS. The regulator argues that there are limits to the principal's control over a contracting party.[172] It is for this reason that the regulator has decided to accredit more broadly than other jurisdictions (ITSRR 2004, p. 26).

This a fundamental issue and a clear difference in risk philosophy and policy. As the NTC (2004, p. 20) notes, the allocation of risk management oversight, set out in Figure 4.5, suggests that only the track manager and train operator need be accredited. This is based on the principle that safety responsibility cannot be contracted away or de facto shifted to the regulator in its role as accreditor (NTC 2004, p. 20). Yet this approach is adopted with the supplier accreditation in NSW.

To some extent, the NSW risk philosophy reflects the investigations into, and recommendations arising from, the Glenbrook and Waterfall accidents. The rationale for optimising or minimising risk appears to be applied piecemeal across different jurisdictions. It can be

171 See NTC (2004, p. 28), for the reference to the NSW accreditation process for suppliers. This approach to risk/risk management seems consistent with that of the National Occupational Health and Safety Commission (2004, p. 2), which notes that '...30% of work related fatalities and injuries were as a result of design issues' and therefore encourages '...any new safety regime to clearly articulate the responsibilities of designers'.

172 NSW argues, for instance, that the responsibility for safe 'hook-and-pull' operations should not reside solely with the accredited principal. This approach can apply in other jurisdictions and may mean that the principal has to present a safe train even where there are multiple parties involved in the operation, for example, rolling stock leasers and contract staff.

inconsistent with other regulatory policy, especially economic regulation, that seeks a viable railway industry.

Where local conditions vary significantly, there is a rationale for risk assessment to be locally-tailored. This is reflected in jurisdictions' legislation. The respective State and Territory rail safety Acts of Parliament require the accreditation authorities to undertake risk assessments. These assessments need to be tailored to the specific locations and types of operation for which the operator is seeking access. The authorities are also responsible for safety performance monitoring, compliance auditing, occurrence investigation, safety information sharing and pro-active safety initiatives.

The accreditation approach is intended to match the needs of the organisation and the operations. For example, as ARSAA notes, the safety requirements for a high-speed urban passenger line differ from a low-utilisation rural line (ARSAA 1999, p. 11). In this context, the operational and physical requirement and risk levels associated with urban rail scenes (in particular) differ so much from other rail tasks that distinct regulation would be required for such operations—even in the event that this regulation was undertaken by a single national safety regulator.

Thus ARSAA argues that the accreditation must reflect the risks in the jurisdiction in which the operator works. These risks vary. For example, rural operation is different to operating in major cities. As we noted earlier, Australia's network has four primary categories of operation and traffic intensity: intensive urban passenger operations with consequently high human safety issues; long-distance intermodal freight; intensive short-distance bulk haulage of ores, minerals and coal; and low-intensity branch line grain haulage.

Thus, the primary differential in accreditation processes is responding to these differing operational environments and risk profiles. However, even where accreditation processes can be segregated in this way, the assessment process is still subjective. Consequently, the granting of accreditation by multiple jurisdictions can result in inconsistent, rather than seamless, processes. As a result, even where operational risks are taken to be identical, different jurisdictions may make variable assessments.

Thus, there is some flexibility in the accreditation terms—which are determined by the State-based regulators. This flexibility has consequences, however. As Affleck notes, although accreditation is facilitated by mutual recognition, the local compliance requirements can be substantial, leading to substantial delays in receiving accreditation (Affleck 2003, p. 20).[173] Industry players also acknowledge that different jurisdictions require varying degrees of detail required for accreditation. So, despite the aims of mutual accreditation, it is 'not fully "mutual"' (NTC Rail Safety Regulation Workshop, 16 June 2004). Maunsell reports that, in 1998 at least, for mutual recognition, '...so much information has to be reproduced to meet the additional requirements of each State that virtually a new application is needed in each jurisdiction' (Maunsell 1998, p. 85). Similarly, Affleck indicates that '...the extent of supplementary local requirements [is] very significant' (Affleck 2002, p. 14). Further, Maunsell argue that the need to also get approval from infrastructure managers '...seriously undermines the one-stop shop principle under the IGA' (Maunsell 1998, p. 86).

Impact of inconsistencies in accreditation across State regulators

What is the impact of the multiple accreditation structure? Undoubtedly, the mutual recognition provision eases the impact of having multiple safety regulators. In 2001, ACIL Consulting sought train operators' experiences with multiple accreditation. They found that:

> ...most operators [surveyed] indicated that they had not faced difficulties in receiving mutual recognition of accreditation, although there are still differences in safety and documentation requirements. (ACIL Consulting 2001, p. 18)

However, despite that, ACIL also noted that '...operators were also dissatisfied with the need to have to consult with so many regulators'; ACIL cited that National Rail, in particular, had to consult with nine regulators (Ibid., p. 18).

Here, therefore, it is important to distinguish between two tasks. First, there is the task involved in receiving accreditation (which ACIL reports was not a serious concern). Secondly, there is the overall

173 An example of accreditation delay is cited in the 1998 'Tracking Australia' inquiry. Northern Rivers Railroad took 12 months to obtain access in NSW and Queensland.

task involved for industry players operating across jurisdictions, in fulfilling the individual safety requirements and in keeping regular dialogue with each safety regulator.

Has this environment changed since 2001—does the multiple accreditation system adversely impact on operators? In March–April and July 2004, BTRE visited a small number of railway firms to establish their accreditation experiences—see Box 2. In essence, our findings echoed those reported by ACIL Consulting. In most cases, there were no significant problems with multiple accreditation. Respondents said more problems occurred because of the ongoing interface with multiple regulators.

Three key conclusions emerged from the bureau's visits. The first is that, despite mutual recognition, actual and interpretational differences remain in the underlying safety Acts. The second is that, despite these ongoing differences—and the need for operators to seek accreditation in each jurisdiction in which they operate—the cost of that duplication is relatively low. That is, multi-jurisdiction accreditation can require some additional costs—notably, in time delays, staff effort and paperwork—but those costs are not significant. Finally, however, although the surveyed firms did not express significant problems with multiple accreditation, they identified ongoing consequences of adhering to, and monitoring, multiple safety systems.

Box 2 Effects of multiple-jurisdictional accreditation

While conducting this study, the BTRE met with a cross-section of rail firms to discuss their experiences with accreditation and multiple regulators. The rail firms we interviewed reported that achieving accreditation outside the home jurisdiction was not an issue. In particular, firms acknowledged that operating conditions-type of infrastructure (including signalling and communications), operating rules and geography-varied across Australia. Some operators indicated that they had experienced delays-or a lengthy process-in achieving accreditation. Where this caused problems, they used facilities and crews from other, accredited, rail firms to enable them to commence operations before they received their own accreditation.

A general conclusion is that where operating environments were similar, such as determined by the geographical environment (because of how it influences risk), identical accreditation requirements should have prevailed. In reality, of course, accreditation and subsequent compliance differs because underlying safety regulations and safety principles differ. We contrast this with what should be the primary need. In a given geographical environment, accreditation should reflect the technical borders-for signalling and communication-and the relevant operator or jurisdictional rule book (such as the PTC Rule Book discussed earlier).

Rail firms interviewed did not consider the accreditation fees to be excessive. They believed they needed to incur such costs to prove their ability to work in different situations.

Multiple accreditation processes were not seen as a significant issue. However, several issues were seen as important-especially to operators moving across jurisdictions rather than operating exclusively within jurisdictions. They include the growth in regulation, inconsistencies in legislation and, particularly, the differences in legislative interpretation and the degree of prescription-that is, the balance of co-regulation between firm and regulator. These factors are compounded by the inconsistencies that arise between infrastructure managers. This is partially attributable to differences in the safety and communications technology used. Firms' bureaucratic input has risen with increased regulator staffing. This generates important management opportunity costs by deflecting time from pro-active safety management.

The rail firms identified inconsistencies in accreditation that arose for two reasons: differences in underlying safety Acts and in interpretation.[174]

Some Acts refer to the need for firms to establish 'interface plans' whereas other Acts require that more formal 'interface agreements' be established between relevant rail firms. One firm suggested this was significant but another firm suggested that it did not make any significant difference.

One firm raised the issue of driver—only train operation. This is permitted on long-distance trains in SA but not in NSW. Thus, a long-distance train in SA driven with a crew of one person is deemed to be 'safe' when approaching the SA–NSW border. But when travelling in identical conditions on the NSW side of the border with identical geography, signalling, communications and signalling—it is effectively deemed to be 'unsafe'. This inconsistency seems more incongruous given that NSW's XPT train—high speed passenger operation—can be operated as a driver-only train. The risk to human life arising from high speed train operation, and the consequences of a driver-related error on such a train, are almost always going to be substantially higher than the consequences of an equivalent error of a driver on a freight train in the same non-urban long-distance operations.

This second point demonstrates that there are fundamental differences in the philosophy between the regulators that go beyond just accreditation. For instance, there is the difference in determining the breadth of accreditation (whether infrastructure managers and train operators are accredited or whether their contractors must also be accredited). This was discussed earlier in this chapter in the section on accreditation. Another issue is the level to which risk needs to be alleviated. Firms need to be able to appreciate and interpret each jurisdiction's philosophy. The regulatory diversity between jurisdictions obviously requires firms to have more resources

174 ARTC's CEO has made a similar point but from a different perspective. He noted that the personality of the regulators differs because of their different backgrounds and this affects how they assess the individual accreditation cases: 'One regulator comes from a signalling background and what you end up having then is 50,000 additional conditions on signalling that were not agreed to by the other two. So, effectively, that does add a significant cost to the gig'. (House of Representatives Standing Committee on Communications, Transport and the Arts 2000, p. CTA 36)

and involves a greater potential for misinterpretation than where there is only one system.

Physical standards regulations

Accreditation processes do not generally specify physical standards for operational purposes. Nonetheless, there are differences in each jurisdiction's safety-standard process that lead to diversity in regulated physical standards.

For example, bogies on rolling stock in Queensland are required to be fitted with cotter pins. These provide a failsafe device for ensuring that the bogie cannot come adrift of the wagon body. However, this is not a requirement in other jurisdictions. Similarly, Pacific National (2003, p. 10) has drawn attention to the inconsistencies with high visibility safety vests for staff in operational areas. Until recently, the required colour varied from State to State—either 'orange', 'burned orange' or 'buttercup yellow'. Pacific National also notes both the setting of different standards and the protracted negotiations required—in this case, four years—to agree upon a standard.

Without a comprehensive survey of all of the technical parameters of the railway—which is beyond the scope of this study—it is not possible to say to what the extent these differences are widespread. However, when we surveyed rail firms and asked them for significant regulatory concerns, the respondents did not volunteer examples beyond those provided above. Thus, while these differences arise, it might be concluded that there is not a widespread divergence in regulated specifications.

Cross-industry regulations and practices

In addition to the industry-specific regulations discussed above, cross-industry occupational health and safety (OH&S) regulations, worker's compensation schemes and workplace relations also affect the rail industry. Inevitably, there are variations in the degree to which these regulations overlap with the industry regulations and vary across jurisdictions.

It is notable that having both OH&S and rail safety regulation leads to an additional safety interface for each regulator. Thus, with each jurisdiction having an OH&S regulator and a rail safety regulator, the number of interfaces is large. The National Occupational Health and Safety Commission has summarised the relationships between each jurisdiction's OH&S regulators and rail safety regulators—see Appendix V.[175] It is clear from the table in that Appendix that there is considerable variation in the relationship between the cross-industry regulations and the rail industry-specific regulations, including overlap of the OH&S and safety regulations. Thus, given that safety philosophies and priorities vary, the interface matrix just between regulators—let alone between regulators and industry operators—becomes very large.

This has implications for resourcing—particularly the skill and experience base for decision-making—and, inevitably, for the desirable safety outcomes. A single (national) rail safety regulator would not eliminate the interface with the multiple OH&S regulators (if these persisted), but it would greatly reduce the number of interfaces involved and thereby concentrate resources more on the task of safety oversight rather than on maintaining relationships with other regulators.

Some specific aspects of non-industry-specific regulations are now considered.

Labour safety regulations

A primary aspect of labour safety in the railway industry is working hours. To an extent the working hours regulations fall under OH&S regulations. Here, however, the boundary between the OH&S regulation and the rail safety regulations is redefined. In this case, more stringent conditions *may* apply for specific railway workers. For instance, in NSW:

> Operators fully complying with the OH&S legislation would already be taking steps to manage workplace fatigue, but the Rail Safety Act 2002 ('the Act') imposes additional requirements because of the potential impacts fatigue could have on passengers and members of the public (NSW Transport Safety and Rail Safety Regulator 2004, p. 2).

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175 In Great Britain, *The Railways Act 2005* seeks to formalise the boundaries between the multi-industry safety regulator and the new railway safety and economic regulator—see below, p. 251.

Drivers' hours are an important example of 'fatigue management'. That is, ensuring that workers do not, or are not required to, work beyond the time when fatigue begins to impair performance. Equally, there is an onus on employees to ensure that adequate sleep and rest are taken so that a worker's ability to perform their duties is not impaired.

Generally, the States and the Territory do not specify given hours of service. However, New South Wales has rail industry hours of service regulation. For instance, for a two-person freight train operation, the maximum shift length is 12 hours (NSW Transport Safety and Rail Safety Regulator 2003a, p. 4). Elsewhere the hours are determined through industrial agreements between unions and management. Victoria has developed a *Code of practice for health assessment and certification for rail safety workers*. This code states that accredited organisations should have effective fatigue-management systems for shift workers (Department of Infrastructure 2003, p. 13). The same code discusses drug and alcohol controls, which are prescribed elsewhere.[176]

Occupational health and safety and worker's compensation schemes

Occupational Health & Safety (OH&S) regulations are concerned with ensuring that employers provide safe working environments. We consider aspects of these conditions.

Fatigue

Fatigue management is considered to be a work place hazard that must be controlled. Each jurisdiction has generic (that is non-industry specific) occupational health and safety laws. The laws vary from State to State. But the onus is on both railway companies and employees to minimise work-related and non-work-related fatigue. In principle, it can be expected that these responsibilities will lead to company procedures and rules that are consistent with OH&S laws. Equally, these employment terms will be consistent with labour-force certification and jurisdiction-based accreditation processes.

These employment terms may be seen as generating de facto inconsistent fatigue regulations across State jurisdictions. But this

176 See the Victoria Government Gazette of 25 June 2002, <http://www.craftpress.com.au/gazette/Gazettes2002/GG2002S108.pdf>

is not an industry-based concern alone—the inconsistencies will be common to all industries that operate in more than one jurisdiction. Consequently, the issue of harmonisation is one that applies at an economy, rather than an industry, level.

As with all other harmonisation issues discussed in this report, there is a strong case for consistency in approach across jurisdictions. However, there is also a case for a variable approach across operating environments, where they different. For instance, specific tasks can be associated with differing levels of fatigue and where the consequences of fatigue vary—depending on factors such as the type of task and monotony involved.

Other OH&S issues

In 2003–04, the Productivity Commission reviewed workers' compensation and OH&S frameworks.[177] Pacific National's submission to that inquiry highlighted the duplication of effort and inconsistencies in interpretation involved in adhering to the requirements of these frameworks across government jurisdictions.

To illustrate: as a national company, Pacific National needs to conform to the terms of seven OH&S Acts and nine worker's compensation Acts. (Pacific National 2003, p. 7) The company noted that compliance with the regulations of two separate workers' compensation self-insurance licences and various jurisdictional policies more than doubles its administrative costs (Ibid., p. 5). Pacific National identified several undesirable duplications.

- **Multiple fees**. The company needs to be licensed for each jurisdiction that it operates in. This means that it is required to pay an annual fee for obtaining and continuing self-insurance for each jurisdiction. (Ibid., p. 6)
- **Diversity in fee calculation**. Pacific National drew attention to the diverse forms of calculating self-insurance contribution fees that are charged by the Commonwealth and NSW (Ibid., p. 6).
- **Compliance costs**. The company incurs additional administrative and training compliance costs due to statutory differences in the

177 See the Productivity Commission's report at <http://www.pc.gov.au/inquiry/workerscomp/finalreport/workerscomp.pdf>

compensation and OH&S regimes. This, the company argued, is a distraction: 'Rather than being proactive and developing better prevention and implementation strategies, internal safety management staff must spend time training and researching jurisdictional differences'. (Ibid., p. 7) [178]

- **Costs of multiple auditing**. Pacific National faces multiple audits. Training processes need to be developed to make them consistent with each set of legislation.
- **Inconsistent monitoring processes** Different definitions, coverage and reporting methods make it difficult to manage workers' compensation and OH&S issues effectively and, therefore, to develop preventative strategies.

The Productivity Commission acknowledged these deficiencies in its compensation and OH&S study. It noted that having to deal with multiple compensation schemes and OH&S regimes imposed significant compliance costs on multi-state employers. Significantly, however—when compared with the approach taken for rail accreditation across jurisdictions—the Commission concluded that mutual recognition in OH&S was not a viable solution to these problems. In its report, it said that mutual recognition:

> ...is not considered viable in view of the administrative complexity and cost involved, and the inter-jurisdictional policy cooperation that would be required. (Productivity Commission 2003, p. XXVI)

Instead, the commission advocated a national solution to the issue:

> A uniform national regime would make it much more efficient for multi-state employers to ensure that their management and employees understand the one set of requirements and any changes to it... Employers could establish a single safety culture, with associated manuals and procedures, throughout their organisations. Employees could be trained in, and understand, the one set of OHS requirements, irrespective of which locality they worked in. (ibid., p. XXVI)

178 It is notable that the Du Pont study of British Rail safety systems, which followed the 1988 Clapham Junction accident (and the subsequent Hidden Inquiry) identified as a 'serious failing' that BR's management of safety practices was reactive rather than proactive. (Gourvish 2003, p. 345) Much of the safety management systems adopted by BR in the 1990s has subsequently filtered into Australian practices.

The commission proposed two parallel systems: a strengthened national institutional structure, and a widened (that is, alternative) single national Commonwealth OH&S and workers' compensation scheme.

Workplace relations

Workplace relations laws are an important aspect of harmonious and safe railway operations. In all but one State, the system is described as being a dual system, with concurrent operation of State and Federal laws. (Since 1 January 2005, the Victorian Government has referred the majority of its workplace relations powers to the Australian Government.) The States have full powers to deal with workplace relations, subject to the Commonwealth's Constitution. The system enables each State and the Commonwealth to make laws about the same issues.[179] It is possible for an employer to operate under multiple systems—that is, Federal and State or States. Thus, it has been noted that the dual system can be even more complicated where businesses operate in more than one State—as do track and train operators (DEWR 2000a, p. 2). The employer may then be subject to different industrial tribunals.

Thus, the system is argued to result in '…wasteful duplication and complexity involved in the operation of a federal and (currently) five separate State workplace relations systems'. (DEWR 2000a, p. 1)

Duplication and harmonisation issues

There are three areas where safety regulations may be perceived to be duplicated:

- there are safety regulators for each jurisdiction where it might be argued that a single authority would suffice;
- there are overlaps between rail safety legislation and OH&S legislation in each State (Maunsell 1998, p. 86, National Occupational Health and Safety Commission 2004, pp. 3–4); and
- where infrastructure managers' and safety regulators' activities overlap. Infrastructure managers and other industry suppliers and users are generally responsible for the terms of operating

179 See Department of Employment, Workplace Relations and Small Business 2000, p. iii.

> procedures and standards. Safety regulators consider more the principles of rail safety, industry party capabilities and adherence to safe practices. In this sense, there is a degree of duplication of activities between the users and the safety/licensing regulators.

We now consider these issues.

Sources of rules and regulations

Duplication of safety regulation impacts on efficiency and entails effort to achieve and maintain a consistent approach. There is a necessary interface between safety regulators' accreditation processes and the infrastructure managers' operating procedures and standards—as embodied in their operating rules.

The federal system of government in Australia has led to the evolution of multiple rail safety administrations. However, it is another issue to debate that such a regulatory structure enhances safety and interoperability relative to a single regulator. Several rail entities involved in the industry have indicated their preference for a single national safety regulator. For example, the Independent Pricing and Regulatory Tribunal (IPART) reported National Rail's view that:

> ...a single national regulator [meaning accreditation authority] would simplify processes, eliminate a lot of duplication across borders and minimise administrative and compliance costs. (IPART 1999, p. 5)

This view is echoed by Queensland Rail, which has argued that a single accreditation body would reduce accreditation costs and minimise applicants' administration costs (Allen Consulting, p. 22). Similarly, Booz Allen Hamilton's 1999 review of rail safety recommended a single national accreditation authority (Booz Allen Hamilton 1999, p. III–7). In their submission to the Productivity Commission's *Progress in Rail Reform* inquiry, ARTC argued that:

> Standard safety levels should apply on a national basis with an operator required to demonstrate adequacy to a single body much like the Civil Aviation Authority (CASA) in the aviation industry. The existence of multiple entities is not only inefficient and costly to users, it is also a waste of resources by the providers, adding to the total national cost of transport services. Moreover, lack of consistency in practices increases total overall risk in the industry. If rail is to be competitive

> then safety must be approached on a commercial basis and ways sought to mitigate risk. (ARTC, 1998, p. 6)

Rail Access Corporation expressed a preference for a national accreditation authority. Its support was conditional on the authority having jurisdiction over both intrastate and interstate lines. Such oversight would exclude standard setting, which the corporation argued is a commercial decision that would be facilitated by the code of practice (RAC 1999, p. vi).

ACIL Consulting reported a similar view by a 'major transport logistics company'. The company favoured a single regulator rather than harmonised regulations:

> So as a general comment, the industry including (our own company) is not in favour of the harmonisation approach—we rather see a proper single regulatory regime apply. (ACIL Consulting 2001, p. 9)

In this context, it might be argued that, in lieu of the current system, there should be a streamlined accreditation system—while recognising that accreditation processes would need to vary depending on the operating environment in which the rail firm was operating (e.g., urban railways or branch line grain lines). Examples of alternative accreditation systems include:

- a single national entity that sets standard regulations, which are then enforced by State and Territory regulators;
- a single, national regulator rather than separate State/Territory regulators;
- a regulator for the interstate network and State/Territory regulators for other (intrastate and urban) lines.

These examples of alternative structures would streamline mutual recognition of accreditation and adherence to safety systems.

Mutual recognition of accreditation

Under the principles of mutual recognition, once an operator is accredited in one State or Territory, it is accepted as having met the requirements of AS 4292 in other jurisdictions—subject to local requirements. The 'home' regulator liaises with other regulators to attain accreditation in other jurisdictions.

Industry players—such as the infrastructure provider and a third-party train operator—identify and evaluate shared risks. They then develop risk management plans. The regulator, through the accreditation process, monitors and audits those plans. Compared with what might be perceived to be mutual recognition, the process is by no means a rubber-stamping of an accredited firm's credentials. In practice the accreditation involves interpretation and adaptation in risk assessment and management.[180] Thus, because of differences in local operational conditions, the application of accreditation principles varies.

So it needs to be accepted that accreditation processes necessarily vary to reflect patterns arising from varying equipment legacy, geographic diversity and differing traffic patterns. IPART argues that:

> ...the requirements for running safe railways in NSW are higher than any other State because of specific geographic and operating conditions. The Great Dividing Range provides for a very steep descent where some of the corridors have a gradient of one in thirty. A significant proportion of track is rated class 1 which in some cases can carry axle loads of up to 30 tonnes, whereas Victoria has mostly class 2 track which can only take loads of 21 tonnes. Also the density of operators in certain NSW rail corridors is very high. (IPART 1999, p. 10)

Thus the accreditation process is tailored to each applicant's circumstances. For instance, the Independent Transport Safety and Reliability Regulator notes (2003, p. 2), 'The level of detail required in the application will vary between different railway organisations, depending on the level of risk and scope of operations'.[181]

180 The Intergovernmental Working Group on Rail Safety reported (1993, p. 49) NSW's view in 1993 that mutual recognition should not be automatic as it '...must take into consideration specific local issues which may not have been addressed in any accreditation assessment process undertaken by another State. Furthermore, there may be circumstances in which an operator proposes to run significantly different services in the different States. Consequently, any existing accreditation may be invalid for subsequent operations'.

181 In terms of the number of accredited entities, 'heritage railways' are a significant sector of the railway industry. In this context, they have distinctly different operating conditions from commercial operations-typically, steam or heritage-diesel locomotive power, old (and often wooden) passenger carriages and volunteer staff (albeit often with experience with working on non-heritage railways).

However, in addition to local operating circumstances, the processes also reflect jurisdictional legislative and interpretative differences. In this context, BHP commented to the Productivity Commission that inconsistencies in the development of accreditation '...lie within the legislative differences between the States'. (BHP, p. 1) Inconsistencies in the regulatory process also arise with varying levels of monitoring and auditing across jurisdictions-as highlighted by IPART (1999, p. 10).

Consequently, operators do not face a simple interpretation of accreditation requirements for a given risk situation. Instead, the rail firm can be confronted with a matrix of requirements for each jurisdiction and for each jurisdiction's interpretation of risk and risk-abatement. Specialized Container Transport (SCT) has noted that, one reason for this is because accreditation is:

> ...a non-prescriptive area... therefore every different person in every different state puts a different interpretation on it. (Productivity Commission 1999, p. 1103)

Similarly, John Holland has argued that the interpretative nature of the processes will always be present in accreditation and regulation and consequently that a single national regulator is the only solution:

> ...so long as there are different regulators/accrediting authorities in each of the different states we will continue to have different "interpretations" on the various standards and codes—including the IGA. It is suggested that the only way that a single uniform application and interpretation will ever be achieved will be through a single national regulator. (NTC 2004b, p. 57)

In conclusion, then, the accreditation process needs to vary to reflect the risk inherent in the accreditation application because, initially, that risk will vary with the type and location of operation. The non-prescriptive aspects of co-regulation mean that it is inevitable that there will then be differing interpretations of appropriate risks, risk allocation, risk level and risk management.

That said, rail firms also face differing accreditation processes because they approach different jurisdictions. The variation in the process arises because of differences in the underlying legislative differences and differing safety principles.

Developments

The general thrust of efforts to establish consistency in safety regulation can be considered in terms of accreditation *processes*, in safety *regulations* and in incident investigation.

Accreditation

While the general principles of mutual recognition of accreditation have been agreed for a number of years, concrete processes that implement those principles are less apparent. At a Special Premiers' Conference in 1991, a discussion paper was put forward outlining the principles for mutual recognition of standards and regulations. Subsequently, the 1993 Intergovernmental Working Group on Rail Safety considered different approaches to mutual recognition in rail accreditation. A decade later, in May 2003, the Australian Transport Council agreed to develop a Joint Rail Accreditation System.

The 'initial principles' agreed in the council's process were to include a one-stop-shop approach to accreditation. It would be available to all industry participants who operate over State borders or multiple jurisdictions; and there would be a single fee payable (ATC 2003). The establishment of a Regulators' Panel, as a forum for discussing consistent operational guidelines and safety regulation, is part of this process.

Despite the additional detail given at this time, some aspects of the system remain at the principles stage. The Australian Transport Council's joint communiqué does not detail what is meant by a 'one-stop-shop' and the concept has been discussed for some years. The 1998 Maunsell report comments that 'The general approach by regulators for a one-stop shop for accreditation is commendable'. (Maunsell 1998, p. 90) However, there is confusion about what a one-stop-shop actually means. Certainly, the track access one-stop-shop means having a system where there are multiple infrastructure managers but where a train operator can negotiate access through one single infrastructure manager.

As ACIL Tasman (2003, p. 14) notes, the shop could take at least one of three forms:

- multiple regulators with enhanced mutual recognition;

- a national regulator forming a company jointly owned by existing regulators; or
- a national regulator established by Inter-Governmental Agreement (IGA) between the Commonwealth and the States.

Thus, despite general agreement across jurisdictions that there is a need for mutual recognition, the movement from principles to practical application has been protracted.

Regulations

There has been recognition of the need to seek and maintain consistency in safety regulations. In 2004 the NTC produced an issues paper on safety harmonisation issues. The commission subsequently reported that industry stakeholders saw a need for greater consistency. An important first step towards regulatory consistency was legislative alignment:

> Stakeholders were clearly of the view that alignment of legislation between jurisdictions was a prerequisite to more consistent regulatory requirements and regulatory practices. There was explicit support for development of model legislation. There is an expectation that this would be a logical step towards achieving a greater degree of harmonisation. (NTC 2004b, p. 57)

Following the same approach, in 2004 the Australian transport ministers requested that the NTC develop National Model Legislation, to facilitate safety regulation consistency. The model legislation was endorsed by the ministers in June 2006; the intention is to transpose the principles of the legislation into each government's regulatory framework.

In its 2004 safety regulation discussion paper, the NTC reported that 'There was strong support for the proposal to establish a single national regulator' (NTC 2004b, p. 57) although there has not been a formal policy response by the Australian governments in response to this view.

Incident investigations

As noted above, in 2005 the ARA's Code Management Company released a draft *Rail Investigations Manual*, to assist accredited railway organisations in applying a consistent approach to incident investigation under the terms of the Australian Standard, AS 4292.7, *Rail safety investigations*.

Costs and benefits of the existing regulatory structure

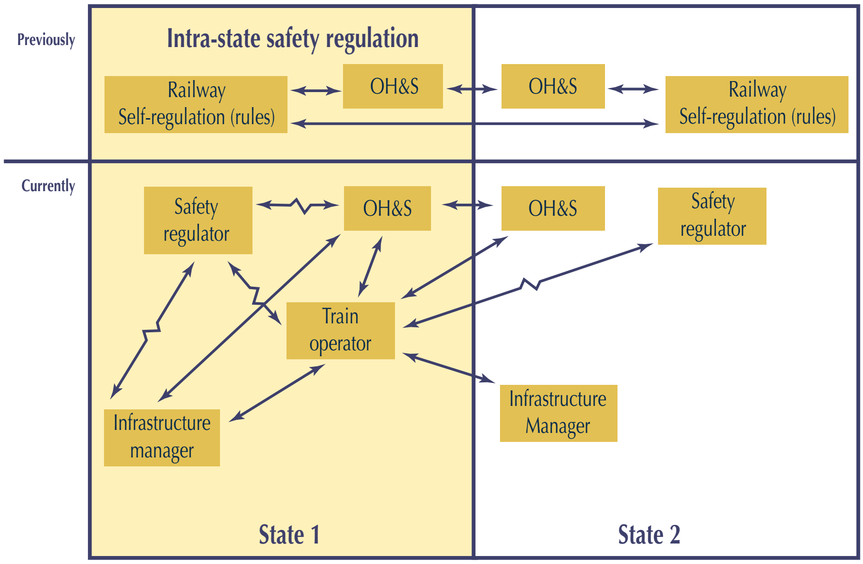
In the last decade, regulation of the Australian railway industry has increased significantly—in safety, access and structural regulation. Regulations invariably impose a cost on those regulated—a cost that is often not evident to the regulators. Even apparently modest regulations can have significant impacts.

It is important to recognise that the costs for individual industry players depend on the extent to which the firm operates in multiple jurisdictions. Where the firm operates entirely within one jurisdiction, it has only limited exposure to the multiple interfaces that come with the current structure. That said, the firm may still face sub-optimal regulation to the extent that skilled regulatory resources are finite and are spread over several entities in different jurisdictions.

There are considerable issues with regulator-industry interfaces as well as with regulator-regulator interfaces. For instance, the boundary interfaces between the new rail safety regulators, and OH&S regulators, (illustrated in Appendix V) are ill-defined. The consequence of these overlaps (or, alternatively, voids) and ill-definitions is that there can be 'fuzziness' of regulatory responsibility and therefore some legal ambiguities. This 'fuzziness' is illustrated in Figure 4.6, which is a simplified schematic of the past and current safety regulatory interfaces that a train operator faces. (The simplification is that the train operator faces these multiple interfaces with every jurisdiction—and infrastructure manager network—that it enters.) The previous interface map was relatively simple and clear-cut and boundaries between entities were better defined. For the current interface map, the figure shows broken arrows to illustrate the imprecise regulatory interface that exists between OH&S and safety regulation; and between safety regulation and train/track operation, this being a consequence of the co-regulatory approach.

As Figure 4.6 illustrates in simplified form, the general issue about the interfaces is the substantial rise in their number in the last decade.

4.6 Simplified schematic of previous and current safety interfaces



Mandated access has brought third-parties into the industry as has the growth in outsourcing of non-core and core activities. Structural regulation has increased the interfaces by separating infrastructure management from train operation. The extraction of safety oversight and accident investigation from the core railway activities to external safety regulators has increased the interfaces as has the introduction of access regulators. This is not a uniquely Australian trend. Indeed, mandated access and structural regulation have become commonplace in many other countries in the last decade. However, what is uniquely Australian is the extent to which the regulation is undertaken at a sub-national level. In this context, the number of interfaces is significantly greater, and therefore more complex, than those other countries.[182]

182 Those regulations are not necessarily tailored for third-party access. Trans-Group (2000, p. 3) discuss Canadian railway safety (where existing third-party access is essentially arranged by voluntary agreement) and the implications of mandated access, noting that '...there are no apparent safety regulations specific to operations under joint or common running rights, other than regulations that apply to the safety of normal train operations'. See page 255 for further discussion on Canadian regulations.

In the case in point, excessive regulation occurs through multiple regulatory systems. These can overlap and duplicate the process that firms need to face. Ironically, it can also mean a very inefficient regulatory system. Typically, each State regulator faces only one major freight train operator and the publicly-owned urban passenger operator. Further, the low industry scale in each jurisdiction means that safety regulation and incident investigation are only practically supplied within the one regulatory body (albeit that this separation was undertaken in NSW in 2005 and is being planned in Victoria); this is arguably inferior to the aviation model of separate independent regulatory and investigation bodies. Thus, what is missed by establishing regulators in each jurisdiction is the opportunity to achieve economies of scale in regulatory oversight in a relatively-small industry—in terms of number of trains moving over the network. Access and safety regulators face similar issues but are separated from each other—hence the development of different access regimes.

Is this good regulation? Gary Banks, the Chairman of the Productivity Commission (Banks 2003, p. 3) notes that good regulation must bring net benefits to society. However, he argues, it must 'be the most effective way of addressing the identified problem' and 'impose the least possible burden on those regulated and on the broader community'. To fit these attributes, he argues that the regulation should:

- not be unduly prescriptive;
- be clear and concise;
- be consistent with other laws, agreements and international obligations;
- be enforceable; and
- be 'administered by accountable bodies in a fair and consistent manner, and it should be monitored and periodically reviewed to ensure that it continues to achieve its aims' (Banks, Ibid., p. 3)

Banks acknowledges that there is limited empirical data on those costs. He argues that in the last decade or so there has been a 'growing realisation' that regulation has failed these tests—especially with compliance costs (Banks, p. 4). More generally, the United States' Office of Management and Budget notes that since regulatory costs can be viewed as benefits foregone or as the opportunity costs of the resources used—they can be difficult to measure. Similarly, it is difficult to estimate the benefits of the regulations (OMB 1997, p. 10). The office identifies the costs as including:

- private-sector compliance costs;
- government administrative costs;
- losses in consumers' or producers' surplus;
- discomfort or inconvenience; and
- loss of time (OMB 1997, p. 10).

There is a difficulty with perceiving what the level of the compliance costs might be. The costs can be much more than the management time that is consumed—there can be considerable opportunity costs. For instance, management focus can be lost if there is excessive regulation. This can arise even with a unitary safety regulatory system. Savage argues that the level and extent of prescribed safety regulations adopted in the United States following the *Federal Railroad Safety Act* of 1970 may have had a detrimental effect in management focus:

> One might argue that the FRA's [Federal Railroad Administration] strategy since 1970 has not only been pointless but actually may have been counterproductive in that it has alienated the industry rather than helped to enrol management in improving safety. (Savage 1998, p. 164)

In its inquiry into workers' compensation and OH&S frameworks, the Productivity Commission noted Pacific National's concern that the costs of multiple regulators extends beyond the administrative costs:

> In addition to the costs imposed by the current multiple arrangements, the need to focus on complying with the differences between jurisdictions was seen as a distraction for management, away from a preferable focus on developing a company-wide culture of preventing injury and illness. (Productivity Commission 2004, p. 21)

Thus, the opportunity cost of duplicated and/or overlapping regulation can dilute safety oversight skills and responsibilities. Extra staff will be required to handle the additional interfaces. However, it may be difficult to recruit such staff because the necessary safety skills can be a scarce commodity.

As noted earlier, there are limits to the skill base on the regulatory side also. In the context of franchising regulation, Gómez-Ibáñez ponders whether or how regulation can be applied in governments with limited resources and without a tradition of technically-sophisticated regulation.[183] The author argues that such regulation can impose disproportionate costs on sub-national governments:

> …simply because the complexity of regulatory problems does not decrease proportionately with the size of the industry being regulated. Subnational governments also have more responsibilities than national governments, and are generally less concerned about the effects their regulatory decisions might have on other investments. (Gómez-Ibáñez 2003, pp. 353–54)

The NTC (2004b, p. 42) notes that if regulators face skill shortages—and this is more likely if jurisdictions duplicate the regulatory task—then it leads to 'ineffective regulators'.

The development of multiple interfaces is a general issue with the restructured railway. The development of multiple regulators escalates these interfaces; this includes interfaces between each jurisdiction's OH&S regulators and rail safety regulators. As the number of interfaces rises, this inevitably means that the decision-making process takes longer and makes consensus more difficult to achieve. This can have safety implications. The reactive process that follows

183 Franchising (also called 'concessioning') is an approach to service provision where the government conducts a competition for private firms to bid for the provision of services, instead of having competition in service provision. In principle, this approach has particular merit where competition in the market is not practicable. The government then regulates the winning firm's activities, to ensure they comply with the terms of the franchise. For a further discussion of the issues, see, for instance, Kain 2006.

the identification of a risk can be made more difficult and, therefore, protracted. Such delays, in themselves, can be counterproductive.[184]

Thus, in this situation, it is possible that any benefits arising from multiple regulation could be exceeded by compliance costs and regulator costs for industry players.[185] This is particularly the case with multiple safety regulators. Firms spend more time reacting to regulatory initiatives than proactively managing risk and enhancing risk strategies. This reduces the time available for safety management.

As BTRE (2003, p. 175) notes, because multiple access regimes can raise transaction and coordination costs, they raise barriers to seamless operation across the network. This impedes rail's competitiveness. This raises the more general issue that the main costs of regulation are not usually evident to regulators as they are borne almost entirely by the regulated. That is, they are external to the government or regulating government agency. Robinson argues that:

As these costs and benefits will necessarily be less than the total costs of regulation, regulation seems bound to become excessive in the sense that if all costs and benefits had been taken into account, it would have been much less. (Robinson 2004, p. 53)

Robinson contends that regulation will frequently reduce society's welfare because of the relatively high proportion of the costs that

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184 What has been assessed as a contributory factor that made the 1999 accident at Ladbroke Grove (near London Paddington station) more likely was the poor visual positioning of a signal; specifically, there was the potential for the signal to be misread. The infrastructure manager, Railtrack, the safety regulator and train operators using the route were aware of the issue for some time before the accident. The Inquiry Inspector, Lord Cullen, noted that 'The recognition of the problem of SPADs in the Paddington area led to the formation of a number of groups to consider the problem. However, this activity was so disjointed and ineffective that little was achieved'. (HSC 2001, p. 3)

185 A consequence of multiple access regulators can be the additional risk arising from a lack of consistency in terms of access. For instance, we can use the National Gas Regime as an example: the Productivity Commission observed that 'The large number of regulators and merits appeal bodies can create the potential for inconsistent outcomes and increase regulatory risk for service providers and third party access seekers'. (Productivity Commission 2004, p. xxx)

are not borne by government. There is no incentive to consider these costs as they are not borne by the entity imposing them. It is against that background that we consider rail with its multiple regulators for each regulatory function.

A cost of multi-jurisdictional regulatory systems can be that they inhibit the optimal provision and operation of infrastructure. Smith and Shin observe that in areas of the economy where the efficiency of 'inter-jurisdictional trade' is important, key technical standards may require harmonisation. They note that, in such situations:

> ...interstate trade in sectors such as electricity, gas, rail, and telecommunications is typically regulated at the national level, including the terms and conditions of access to relevant network facilities. (Smith & Shin 1995, p. 55)

What are the incremental benefits that are perceived to flow from regulation being applied at multi-jurisdictional levels? In September 2002, the Productivity Commission released the report of its inquiry into the National Access Regime. The Queensland Treasury, in its submission to the inquiry, argued in favour of multi-jurisdictional regulators, on the basis that having just a single regulator

> ...may reduce the rigour and robustness of the regulatory competition and innovation associated with multiple regulators. (Queensland Treasury 2001, p. 12)

Thus, one case for multiple regulators is that regulatory competition generates benefits in the form of better regulatory oversight and, therefore, benefits operators indirectly. But then, multiple access regimes could still benefit from a more coordinated approach. The Productivity Commission has observed, for example, that two jurisdictions conducted separate reviews into their access regimes when benefits existed for taking a coordinated approach (Productivity Commission 2005, p. 223).

Further, putting aside sovereignty issues, an additional premise, or potential net benefit, of multi-jurisdictional regulation is that:

- local conditions vary sufficiently for regulation to have to be tailored to those specific local conditions; and

- it is better that those local conditions be applied by local rather than national regulators.[186]

Do local conditions actually vary by jurisdiction rather than by topography or rail corridor—reflecting the level of traffic on that route? As noted earlier, optimal regulatory diversity needs to reflect variations in industry size, locational intensity of operation, railway viability, traffic mix and types (especially urban passenger operations), operational terrain, policy environment and types/specifications of equipment used. There will be some correlation between a jurisdiction and the type of equipment used—if only because of the legacy of jurisdictionally—based management of State-run railways—but arguably the linkage is not pervasive nor is the choice of a given standard unique to a given jurisdiction. That is, in general, the environment within which a railway operates will vary *within* a jurisdiction and yet there will be railway attributes that are common *across* jurisdictions. Thus, the jurisdictional border does not generally define unique circumstances that would justify bespoke regulations within each border. By contrast, there are common regulatory issues across jurisdictions that call for common approaches. For instance, there are strong similarities between the coal haulage in NSW and Queensland. While recognising that the two mining areas are serviced by different railway infrastructure providers, the underlying pricing principles should be identical. Despite this, the two jurisdictions establish independent infrastructure charging reviews and make independent deliberations on charging principles.

An important consequence, then, of separate charging deliberations in each jurisdiction is that rail firms unnecessarily incur additional transaction costs in access. Similarly, the jurisdictional border does not necessarily change the way that the firm needs to operate. As a consequence, additional transaction costs arise as industry players in each jurisdiction need to seek and maintain accreditation for

186 Smith & Shin (1995, pp. 53-54) advance four arguments for decentralised regulatory responsibility: (a) that local conditions and preferences shape the regulatory objectives and approaches; (b) the regulatory authority can be closer to the affected firms, ameliorating information asymmetry problems; (c) similarly, in being closer to the firms, the regulator is made more responsive and accountable; and (d) it '...can foster experimentation with innovative approaches to regulatory problems'-a form of regulatory competition.

essentially identical operating circumstances. In a similar vein, operators may need to acquire multiple rolling stock accreditation; when the accreditation may be needed to reflect so-called local circumstances but, if these circumstances are not unique to a jurisdiction, then the accreditation cannot add worthwhile safety scrutiny and merely adds to transaction costs.

In their review of the design of regulatory institutions and the transaction costs that arise from regulation, Estache and Martimort observe that:

> The Folklore of the Public Economics literature argues that decentralization is good because it allows local powers entitled with regulatory rights to use their local information to improve the provision of regulation, redistribution, or the production of public goods at the local level. The standard argument is that these benefits of decentralization must be traded off against the costs coming from the lack of coordination in the regulatory policies of the competing states. Externalities arise from this decentralized exercise of regulatory rights. (Estache and Martimort 2000, p. 19)

Estache and Martimort argue against this rationale. They suggest that this view assumes that local regulators are unable to pass along the regulatory chain the information learned at the local level. If such a communication channel is available, '...a grand and centralized mechanism would be enough to coordinate all jurisdictions'. (Estache and Martimort 2000, p. 19) They also argue that there are '...decentralized ways of implementing the optimal coordinated regulatory policy' and that '...the Federal level can achieve the efficient policy by letting local jurisdictions have the formal authority for implementing local regulation' (Ibid., p. 19)

Table 4.6 summarises the costs and benefits of multi-jurisdictional regulators. It is not possible to quantify these costs and benefits. It is evident, however, that it is readily possible to challenge the apparent benefits of multi-jurisdictional regulators. What is clear, numerically, is that the number of industry interfaces has increased significantly since the early 1990s, Each additional regulator has increased the regulatory burdens on railway firms, potentially blunting railway firms' proactive safety oversight.

4.6 Overview of costs and benefits of multiple regulators[a]

	Category	*Regulators*	*Industry*
Costs	Financial compliance	Cost of duplicated bureaucracy	Additional fees arising from duplicated effort
	Opportunity cost		Effort diverted from proactive safety oversight to reactive oversight
	Skill base	Diluted skill and experience base for scarce resources increases likelihood of regulatory failure	
	Consistency	Effort required to seek and maintain consistency in regulations. Dynamics of regulation become muted in pursuing this process or regulatory inconsistency emerges.	Scarce safety management resources diverted to oversight of regulatory plans. Multiple regulators reduce the predictability of regulatory outcomes, thereby increasing investment risk
	Training		Additional training required for similar operational/geographical situations
	Safety risk		Suboptimal inconsistencies can blur safety—additional effort required to ensure compliance in multiple jurisdictions
	Competition		Additional bureaucratic requirements required for dealing with each regulator may mute incentives for operators to expand into other jurisdictions
	Decision-making process	Decision-making can be protracted due to the need to reach consensus	
	Regulato ry structure	Division of industry into small State-based systems leads to compromise on optimal regulatory structure e.g., where safety regulation and incident investigation are under single body	
	Regulatory ambiguity	Regulatory gaps and overlaps at interfaces lead to suboptimal regulation, especially when regulations differ	
Benefits	Safety focus	Safety environment can be set to reflect local conditions	Firms operating within small defined geographical or operational working environment may find it easier to conform to safety requirements
	Regulation	Multiple regulators introduces competition in regulation, enhancing rigour and encouraging innovation	Firms may benefit from regulatory competition and be encouraged to lobby for adoption of better regulatory processes where systems have been proven to work

a In this table we consider regulation only within a regulatory area; we do not consider the possible adverse impact of multiple regulators for each of safety, access and economic regulation. In essence, the costs arise in that objectives set by one regulator may not be consistent with objectives set by another regulator. Conversely, it might be argued that consolidating these regulatory issues within the one regulatory office would increase the likelihood of 'regulatory capture'.

Overseas trends in railway regulatory oversight

Australia's primary railway policy changes of the last decade—privatisation, mandated access and structural regulation were inspired by European policy changes dating from around the same time. It is therefore instructive to consider more recent developments in the European Union and its Member States, and also in Great Britain, where the most significant policy reforms have occurred.

As Figure 4.3 illustrates, there are two aspects where Australia's railway network differs from these other major systems:

- it is 'co-regulatory' rather than 'prescriptive'; and
- there are multiple regulators—there is a regulator for each State rather than a single, national regulator.

In that context we now consider developments in other countries.

The European Union

Member States of the European Union are required to transpose the terms of Directive 91/440/EEC (and complementary successor Directives), mandating third-party or open access to the railway infrastructure. Terms of access remain loosely defined at the federal level; access regulation is undertaken at the State level. BTRE (2003, pp. 122–26) reports that the looseness of the regulatory framework has meant that terms of access (notably, pricing) vary considerably across the Union. Consequently, it results in confusing track use and investment incentives.

The European Union has sought to achieve greater harmony in its safety and technical standards. A notable step in safety overseeing was the issuing of the Railway Safety Directive, 2004/49/EC, in 2004. The Directive establishes common *principles* (rather than more specific, common, regulations) for safety management. The Directive includes Common Safety Targets (CST), on which it seeks to achieve and to maintain consistency:

> New national rules should be in line with Community legislation and facilitate migration towards a common approach to railway safety. All interested parties should therefore be consulted before

> a Member State adopts a national safety rule that requires a *higher* safety level than the CSTs (European Parliament 2004a, p. L 220/17) [emphasis added].

A complementary activity here was the establishment of the European Railway Agency (ERA), also in 2004. On this, the European Commission notes:

> In the past, railway safety was a purely national matter, in that the national markets were closed. However, as access to railway infrastructure from one Member State to another has gradually been opened up, a need has emerged to develop common approaches to safety for two reasons. First, to ensure high safety standards as the market is opened up to more and more operators. And then to allow efficient use of this access to infrastructure, without which incompatible national safety regulations would create new barriers to entry. Another reason for establishing the Agency is the need to speed up the progress on interoperability and to provide stable, sufficient means for doing so. (European Commission 2004)

Given this environment, the commission sees the main task of the Agency as being to provide a common framework for:

- access to railway infrastructure;
- allocation of railway capacity;
- infrastructure charging; and
- licensing and safety certification (European Commission 2004, p. 1).

In recent years, legislative support for interoperability in the European Economic Area has come through Directives 96/48/EC, 2001/16/EC and 2004/50/EC. The ERA will oversee technical regulations and standards, areas of operability and safety. It will formulate '...common solutions on matters concerning railway safety and interoperability' and seek common safety targets and common safety methods (EC 2004).

The agency's role is to direct policy. Nonetheless, it is an additional entity and European directives require each Member State to have a regulatory body to oversee access issues.[187]

187 See Article 10.7 of Directive 2001/12/EC and Articles 30 and 31 of 2001/14/EC.

In the context of Australian State structures, it is notable that under Directive 2004/49/EC (European Parliament 2004a, p. L 220/28, Article 21), each Member State in the Union is required to keep its railway investigating body functionally independent from the safety regulator or any other railway regulator.

Another notable development in the Union will be the introduction of a pan-European 'drivers licence' for train drivers (EC 2003; European Parliament 2004).[188]

Great Britain

The implementation of the 2004 White Paper policy for Great Britain has brought about the merging of safety, access and economic regulatory activities (bringing some activities from the Strategic Rail Authority and from the Health & Safety Executive (HSE))[189] to form the Office of Rail Regulation (ORR). In establishing a single regulator for safety regulation, performance and costs, the Department for Transport (DfT) sees an industry structure that is clearer and simpler (DfT 2004, p. 92).[190] Operating rules and regulations on the network are those of the infrastructure manager (such as Network Rail or London Underground). The Rail Accident Investigation Branch, established under the Railways and Transport Safety Act 2003 (and following Lord Cullen's inquiry recommendations for an independent investigation body, following the 1999 Ladbroke Grove accident), is an independent railway accident body, under the DfT umbrella

188 DOI (2004, pp. 68-69) considers the merits of driver and signaller licensing for the Victorian railway network and if merits exist, of using the Joint Accreditation System of Australia and New Zealand to accredit a State body to issue the licences.

189 The HSE is a multi-industry safety authority. Safety functions under the Health and Safety at Work etc Act 1974, are transferred to ORR.

190 Smith & Shin (1995) have reviewed this issue of the functional breadth of the jurisdiction. They pose the question '...whether the body responsible for economic regulation of an industry should also have responsibility for safety, environmental, and other regulation. While international experience is mixed, two general principles are widely accepted: where regulatory capacity is limited, a smaller number of regulatory agencies is preferred; and where several regulators are involved, the respective jurisdiction of each should be defined as precisely as possible to reduce uncertainty, duplication, or conflict. Moreover, where two or more regulators are responsible for closely related aspects of the same industry-such as water quality standards set up by an environmental regulator and water rates set by an economic regulator-close coordination will be required to ensure effective regulation'. (p. 59)

(DfT 2002, p. 5). The Railways (Accident Investigation and Reporting) Regulations 2005 detail the scope of the Branch.

In many respects the rail reforms in Great Britain since 1992 have provided the template for the patchwork of reforms—privatisation, mandated access and structural regulation—that have been adopted in Australian jurisdictions.[191] Indeed, since the renationalisation of Britain's track infrastructure (Railtrack—and its successor organisation Network Rail) in 2001–02, Australia's reforms provide the most ambitious remaining examples of these policies.

There has been concern with the number of interfaces in the British railway system following the reforms. Following Railtrack's move into financial administration in 2001, there has been considerable concern with the escalation in operational, renewal and investment costs in the railway. A review of the railway industry was commissioned. This centred on the industry structure, particularly the regulatory form. The 2004 White Paper, *The future of rail*, which resulted from this review, concluded that:

> ...the current industry structure too often hinders progress. It is not the individual elements of the privatised railway that are most problematic. It is the complex interfaces between them that are at the root of its difficulties. (DfT 2004, p. 17)

It is noteworthy that the White Paper (and subsequent Railways Bill—see House of Commons 2004, and Railways Act 2005) considers that its reforms to improve rail safety regulation move it within the framework set out in the European rail safety directive.

The shift of railway activities[192] from the HSE multi-industry authority to the industry-specific ORR economic and safety body inevitably means that interfaces of oversight will be created between ORR and HSE but the interface terms are being explicit. (This situation can

191 While the term 'patchwork' seems a strong description, it should be remembered that although the different jurisdictions share mandated access, in other reforms they differ significantly. For instance, of the reforms, in Queensland the railway remains integrated and publicly-owned, in Tasmania the railway is privately-owned but with an effective presumption against access.

192 The Railways Act 2005 '...will transfer functions of the HSC [Health and Safety Commission] (essentially policy functions under the Health and Safety at Work etc. Act 1974 (HSWA)) to the ORR in respect of "railway safety purposes"'. (ORR 2005, p. 3)

be related to the interfaces between Australia's OH&S and each jurisdiction's safety regulator—see Appendix V.) The Railway Enforcing Authority Regulations will be used to define the precise boundaries of responsibility and oversight between the two organisations (ORR 2005, pp. 4–5). Under the new regulations ORR will be responsible for enforcement for railway-specific and general health and safety provisions on the railway. Principles that underlie the restructuring include that:

> ...post transfer, there should be a single enforcing authority for the railway industry as far as possible, minimising circumstances where rail duty holders need to deal with both ORR and HSE at one location for the same activity [and that] the lead enforcing authority for any part of the rail industry... should be determined by the nature of the principal risk involved, and take account of the relevant expertise available within ORR and HSE. (ORR 2005a, p. 4)

The White Paper argues that a single regulatory system provides an opportunity to develop an independent regulator with specialist economic and safety rail expertise. This, in turn, means that '...decisions which touch on both economic and safety regulation to be brought together'.[193] (DfT 2004, p. 50)

The White Paper addresses concerns about the escalation in safety costs. It nominates the Office of Rail Regulation to of encourage the industry to take responsibility for its risk assessments '...rather than focusing on unquestioning technical compliance'. (DfT 2004, p. 51) Here, the paper calls for a cultural change, and seeks a '...move away from a culture where standards are followed unquestioningly, whatever their impact, and move to a risk-based safety system where decisions are taken based on proper analysis'. (DfT 2004, p. 51)

The paper talks about change management and notes:

> Whereas other industries have introduced procedures based around the careful analysis of risks, the rail industry's approach tends to be focused on huge number of rigid standards, often based on expensive engineering solutions. While this helps ensure compliance with minimum standards, it does not always incentivise the industry to find

193 This includes the enforcement of health and safety legislation as it relates to the railway industry (DfT 2004, p. 52). ORR will also be a '...single repository for rail industry data'. (Ibid., p. 53)

> the most appropriate or innovative solutions to safety issues, and can often mean investment does not address the most important problems. The industry clearly needs to tackle the plethora of standards and create processes based on a proper assessment of risks. (DfT 2004, p. 39)

An important aspect of the new structure is that it aligns the safety regulator's decisions with those of the access and economic regulator. This brings a consistency of decision-making that hitherto was absent. Rail Business Intelligence observes:

> Introducing commercial common sense into what has been seen as "cost no object" safety regulation is, of course, one reason why the white paper proposed that safety regulation should be transferred from HSE to ORR. (RBI 2005, p. 7)

Crucially, the new structure links the viability of the train operators—which is part of the economic regulation decisions—with the access and safety decisions. That is, the regulator becomes accountable for the decisions made. For instance, the Canada Transportation Act Review Panel argued that the host railway's infrastructure payments from a third-party operator should include compensation for any new investment and incremental operating expenses required '…to maintain a high standard of safety on shared track'. (Canada Transportation Act Review Panel 2001, p. 82) In this context, the granting of access and safety are intertwined issues.

The move to merge safety regulation with economic regulation is, however, contentious. In his World Bank report, Thompson notes that:

> The recent proposals to combine the functions of the ORR [economic regulator] and the safety regulators may well integrate safety issues more directly into system planning; but, they also challenge the regulatory authority to find transparent, rational and consistent means within the context of a single agency to resolve conflicts between system safety and system economics. (Thompson 2004, pp. 25–26)

Consistency in decision-making and reducing the number of interfaces are seen as key benefits of the regulatory consolidation in Britain. The British taxpayer significantly underpins most of the railway operations—passenger and freight and infrastructure. But, compared with the previous structure, the single regulator ensures that the three regulatory decisions are inter-linked within the same agency. This should result in greater consistency because the decision-making is occurring from one entity rather than three.

Another restructuring in the safety area was the formation of the Rail Safety and Standards Board in 2003. This transferred the main functions of the Safety and Standards Directorate—a unit owned and controlled by the infrastructure manager, Railtrack.[194] The Board, however, '…owned by the railway industry', is responsible for safety research and a range of industry standards. It is not directly involved in safety regulation.[195]

Denmark

Banestyrelsen (Danish National Railway Agency) is Denmark's vertically-separated infrastructure manager (excluding stations). The British restructuring of its regulatory oversight has closely followed restructuring in Denmark. On 1 July 2004, the rail safety authority (Jernbanetilsynet) was abolished. Its safety management tasks were transferred to the National Rail Authority (Trafikstyrelsen). Like Britain's new Office of Rail Regulation, Trafikstyrelsen's role includes responsibility for access and economic regulation and safety.

Rail accident investigation is handled by Havarikommissionen for Civil Luftfart og Jernbane (the Danish Accident Investigation Board), which also investigates air accidents. The Board is an independent agency within the Ministry of Transport.

Sweden

Banverket is Sweden's (vertically-separated) rail infrastructure manager. Sweden has introduced reforms that closely follow those of Denmark. Following the passage of the Railway Act (2004: 519), on 1 July 2004, the Swedish Rail Agency (Järnvägsstyrelsen) was formed. The agency is responsible for monitoring infrastructure charges, capacity allocation and safety matters.

194 The transfer follows the recommendations in Lord Cullen's inquiry into the 1999 Ladbroke Grove (London Paddington) accident.

195 One proposal was for the rail safety research activities to be incorporated within HMRI (that is, within ORR), thereby further consolidating safety oversight. See House of Commons Transport Committee 2004, p. 18. House of Commons Transport Committee (2004, no page numbering) refers to RSSB as being owned by the industry.

The independent Statens haverikommission (Swedish Accident Investigation Board) is responsible for investigating railway accidents and incidents.

NAFTA countries

The 1994 North American Free Trade Agreement (NAFTA), between the countries of Canada, Mexico and the United States, requires the member countries to seek harmonisation of regulatory standards so as to allow free operation by transport companies across borders within the Area.

Railways in NAFTA countries are not subject to mandated access regulation. However, they are required to give passenger train operators—for example, Via Rail Canada and Amtrak—access to track and some railway privatisations have required that some third-party access be provided (see BTRE 2003, p. 114 and 122). As was undertaken in Great Britain before nationalisation, these railways set bilateral voluntary agreements for access to each other's track. Access and safety terms are set by the respective host railway (BTRE 2003, Chapter 4 and Trans-Group 2000). Consequently, without the heightened safety issues arising from the additional interfaces that come with mandated access, there is not the same emphasis on safety issues in NAFTA countries. Therefore, the access and safety regulatory bodies are less prominent.

Canada

The Canadian Transportation Agency (CTA) is Canada's federal equivalent of an 'economic' regulator, in the same vein as ACCC is to ARTC or ORR is to Great Britain's Network Rail). The agency deals with railway rate disputes between shippers and railway companies. Canada's federal railway safety is overseen by Transport Canada. Incident investigation is undertaken by the independent Transportation Safety Board of Canada.

As illustrated in Figure 4.3, Canada's railway safety regulation is similar to Australia's in that it is based on the co-regulatory model. However, despite being a confederation, the regulatory structure is essentially federally-based. Railway safety for federally-regulated railways is regulated by Transport Canada through the Railway Safety Act (1985, amended). Where a railway is deemed to be federally-regulated, Transport Canada's rules take precedence over provincial regulations. A railway becomes federally-regulated when:

- the railway crosses provincial boundaries;
- the railway crosses international boundaries;
- the railway is owned, leased, controlled or operated by a federal undertaking;
- if the railway is existing as part of a federal undertaking; or
- 'if it is for the general advantage of Canada'. (Federal-Provincial Working Group on Rail Safety Regulation (FPWG) 2001, pp. 7–8.)

The issue of railway harmonisation has increased significantly in recent years, due to the increase in the number of railways that are subject to provincial regulations. The number of intra-provincial railways increased significantly during the 1990s as the national operators (Canadian National, Canadian Pacific Railway) transferred branch (or short-line) railways to new local firms; this has increased focus on federal-provincial regulatory consistency.

In *principle*, provinces accept the need for their railway regulations to be based on federal regulations. There are three Canadian approaches to safety harmonisation:

- **Delegation Model**. The province of Ontario *delegates* the core of its regulatory powers to the federal government, in regulatory terms, inspection and enforcement—though not in railway licensing.
- **Reference Model**. Manitoba, New Brunswick, Nova Scotia and, more recently, Alberta and British Columbia, use the *Incorporation by Reference* model. Here the provinces transpose federal regulations, though this is not automatic. Thus, it is possible for the provincial regulations to drift out of consistency as there is an 'absence of a single, reliable vehicle for keeping abreast of current federal requirements'. (FPWG 2001, p. 35)
- **Consultation Model**. Saskatchewan and Quebec follow the *consultation* model, where the province creates regulations, standards or rules independently of the federal government, even though in practice they are based on federal regulations. Again, amendments and revocations of regulations are not necessarily

captured at the provincial level and safety philosophies diverge—notably that of the degree of prescription (FPWG 2001, p. 28).

Thus, apart from how each province sets regulations, they may have independent inspection and enforcement; of equal concern is that the federal regulatory revision process that comes with performance-based standards, almost inevitably leads to disharmony under the reference and consultation processes. It has been noted that

> ...provinces who choose to mirror federal law may lose consistency as federal regulations they have consulted are repealed and replaced with performance-oriented rules. (FPWG 2001, pp. 10–11)

The Association of Regional Railways of Canada (ARRC) has two concerns:

- **Divergence in regulations**. The federal and provincial safety regimes are not identical; ARRC notes that some provinces, such as Ontario, have incorporated the federal Railway Safety Act into their legislation and Transport Canada is contracted to inspect and oversee its railways. By contrast, Quebec and some other provinces have separate legislation and regulatory management
- **Regulatory gaps**. There can be regulatory gaps in safety regulation where federally-regulated and provincially-regulated railway operations converge. Boucher (2002, p. 4) notes, for instance, that Via Rail is a federally-regulated railway that runs trains on the provincially-regulated New Brunswick East Coast Railway; it is unclear here whether federal or provincial safety regulations prevail.

Thus, greater consistency is sought. The 1994 review of the Rail Safety Act concluded that a consistent and national scheme is needed (Transport Canada 1994). The review concluded that the regulatory system '...must be changed to one that is both non-prescriptive and industry-driven' (Ibid.). The 2001 Canada Transport Act Review Panel reported that regulations were becoming less prescriptive and that industry was taking a greater role in setting them. CTARP 2001, p. 89) The Panel also recognised '...the need for greater federal/provincial regulatory harmonization in the area of railway safety'. (CTARP 2001, p. 89) This view was echoed by the Working Group of the Federal-Provincial Regulatory Regimes Harmonization

Project. Since the project was initiated, the provinces of Alberta and British Columbia have strengthened their ties to the federal regulatory structure by shifting from the Consultation Model to the Incorporation by Reference Model.

Since 1989 at a federal level, there has been a shift away from prescribed regulations and towards rule-making at the individual railway company level. This co-regulatory nature of regulations is illustrated in the safety processes for third-party access. To the extent that the railways have joint operation of a line or a host railway permits third-party operation over its tracks, additional safety rules are inevitable. As Trans-Group report, however, the rules for these situations are, like other safety rules, defined by the railways themselves rather than defined by Transport Canada or provincial authorities. (Trans-Group 2000, p. 34) Indeed, more generally, while all Canadian railways conform to the Canadian Railway Operating Rules, differences remain in their interpretation, training and application. The differences are usually set out as special instructions. However, crucially, the difference is not as significant as it might appear. The railways '…are free to enhance but not take away from a rule'. (Trans-Group 2000, pp. 13–14)

Trans-Group note that while intra-provincial (short-line) railways do not have to abide by the Transport Canada safety regulations, in practice they usually adopt them. However, there can be greater latitude with the provincial regulations. Thus, it has been observed that:

> Though the Saskatchewan Railway Act was passed in 1989, regulations to accompany the act have not been written. In practice, this has meant that safety practices and operational decisions have largely been left to the discretion of the short line operator. The primary requirement in this regard is the need to obtain an engineer's certificate that certifies the rail line is "safe and adequate for the railway operations as specified in the certificate". In recent years, Saskatchewan Highways and Transportation has been more diligent in inspecting provincial short lines to ensure they are operating safely.
>
> In contrast, federal regulations are more specific and more onerous. The federal regulatory body is less likely to consider specific individual circumstances that may pertain to a small rail operation. (Beingessner 2005, p. 68)

If short-line operators run over national (Class 1-Canadian Pacific or Canadian National) tracks, they have to satisfy Transport Canada conditions that their rolling stock and locomotives meet Association of American Railroads (AAR) safety and operating standards (Trans-Group 2000, p. 16) and the rules of the track-owning company.

An important group of operations are the commuter railway services; despite their typically intra-provincial operations, they may still find themselves pursuing federal regulations and subjected to federal enforcement. This arises, in particular, where commuter services operate on inter-provincial railways and are crewed by the staff from the inter-provincial railway. For instance, GO Transit in Toronto (Ontario) operates, in part, over Canadian National tracks and its trains are crewed by Canadian National staff. GO Transit (as an intra-provincial railway) is not subject to Transport Canada regulations or enforcement. However, because Canadian National is a federally-regulated railway, Transport Canada does have regulatory authority and enforcement powers over Canadian National. Thus, Canadian National is required to ensure that GO Transit follows the federal regulatory regime and that it adopts Canadian National's operating rules.

United States of America

Until 1996, when it was abolished, the Interstate Commerce Commission was the railways' economic regulator.[196] Economic regulatory activities are now overseen by the Surface Transportation Board (STB)—an independent agency of the Department of Transportation. Rail industry-specific safety regulation in the United States is set by the Federal Railroad Administration (FRA), which is also an agency of the Department of Transportation. This oversight applies to freight and passenger operations alike, despite the intrusion of freight operations through urban passenger train 'islands' (akin to freight movements through Sydney's CityRail network).[197] The investigation of major railway accidents (accidents involving

196 Gómez-Ibáñez refers to research that claims that the single most important advocates who pressed for the establishment of the ICC were the railways themselves, '...because the ICC could protect them from aggressive state regulators and provide the means for suppressing rate wars'. (Gómez-Ibáñez 2003, p. 43)

197 These shared-track operations include the cities of San José, New York, New Haven, Boston and Los Angeles.

passenger trains, fatalities or major property damage) is undertaken by the independent National Transportation Safety Board.

The experience of railway regulatory oversight in the United States in the last few decades has been two-fold. There has been a strong move away from economic regulation and an initial move towards greater prescriptive safety regulation. This had subsequently led to a shift away from unilateral prescription and towards a more consultative oversight with industry. Safety regulation is essentially a federal matter although issues such as the level crossing interface also involve lower tiers of government. From the early days of the railways, there has been a strong Federal involvement, at the behest of State governments and indeed some railways. On this, McDonald notes that:

> By the mid 1880s a number of states had passed laws to regulate railroads, including safety legislation. As might be expected the requirements of the various state statutes were conflicting and difficult for the railroads to implement. As a result state governments as well as some segments of the railroad industry began to urge Federal legislation to provide a workable set of standards. The railroad industry recognized the disadvantage of state by state regulation. (McDonald 1993, pp. 6–7)

The bankruptcy of six major north–eastern railways around 1970- notably, the bankruptcy of Penn Central, the largest-ever United States corporate bankruptcy to that date—focused attention on the ICC's economic regulation. *The Railroad Revitalisation and Regulatory Reform Act* of 1976 and the *Staggers Act* of 1980 substantially reduced the extent of that regulation.

This regulatory retreat contrasted with safety regulation. The FRA's safety regulations date from 1893 with the establishment of the Interstate Commerce Commission's Bureau of Railroad Safety. In 1970, the *Federal Railroad Safety Act* was a major first Act setting a trend in expanding the level of prescriptive rail safety regulation.[198] This included issuing rules on glazing of windows, radio use, control of alcohol and drug use and track standards, with a strong emphasis on national uniformity of safety standards (McDonald 1993, p.

198 The Act itself was repealed in 1994 but the regulations and other railway safety statutes were re-enacted as chapters 201-213 of title 49, United States Code (GAO 1997, p. 3).

21). Further, in 1991, the administration established a programme of certification of train drivers (echoed later in the European Union). Because of the diverse operating conditions across the network, which would have made it difficult to develop a practical national standard, the administration required the railways to develop their own certification standards (McDonald 1993, p. 26).

Following this pattern away from the prescriptive approach, in 1993 the administration initiated what it regarded as a more flexible and consultative approach to regulatory oversight. This led to the establishment in 1995 of the Safety Assurance and Compliance Program. Through this programme, the FRA '...works cooperatively with railroad labour and management to identify and solve the root causes of systemic problems facing the railroads'. (GAO 1997, p. 4) Further, in 1996, the FRA established the Railroad Safety Advisory Committee, with members drawn from government, management and unions. The committee reviews the development of new regulatory standards for their practicality, effectiveness and cost-efficiency (Savage 1998, p. 163).

It is notable that economic and safety regulation fall under the same Department of Transportation administration although the STB and FRA operate as autonomous agencies. Similarly, the Federal Transit Authority (FTA) falls under the same DOT umbrella; this Authority funds urban transit systems and oversees their safety.

An important contrast in safety regulation between the United States' federation and Australia's is that United States' safety regulation is undertaken by the Federal government:

> ...with the exception of self-contained urban rapid transit systems, FRA's statutory jurisdiction extends to all entities that can be construed as railroads by virtue of their providing non-highway ground transportation over rails or electromagnetic guideways, and will extend to future railroads using other technologies not yet in use'. (USA government)

This oversight *includes all* commuter operations. Urban transit operations are excluded from FRA's jurisdiction only if they are 'not connected to the general railroad system' (*Ibid*.). FRA distinguishes an urban transit operation from a commuter operation when it is a subway (underground) or elevated operation on which no other railways operate, has no highway level crossings, operates within an urban area and its primary task is for moving urban passengers. The urban transit systems excluded from FRA oversight are, however, regulated by the FTA. Crucially,

> …the safety rules of FRA and FTA are mutually exclusive. If FRA regulates a rail system, FTA's rules on state safety oversight do not apply. Conversely, if FRA does not regulate a system, FTA's rules do apply, assyming that the system otherwise meets the definition of a "rail fixed guideway system" under 49 CFR 659.5. (FTA 2000, p. 42526)

While the FTA provides overall regulation of the urban transit systems, the FTA approves a State-nominated State Safety Oversight Agency to undertake the oversight and enforcement of FTA-approved regulations and this includes more specific standards that the relevant rail transit authority must abide by. (FTA 2005 contains information on these standards.)

These transit systems are literally physically-isolated islands that do not interact with the conventional railways or with highways. In principle, European trends in new transit operations have seen urban transit routes making incursions onto conventional railway rights-of-way. Recognising this, the FRA notes that such operations may seek to share track with conventional (FRA-overseen) trackage. On such trackage, the FRA jurisdiction would prevail. Outside of this shared-track area the FRA would not extend its jurisdiction. However, the technical standards of transit vehicles (such as structural integrity of vehicles in the even of a collision) are low relative to conventional systems and 'FRA and FTA have grave concerns about whether, given their structural incompatibility, light rail and conventional equipment can ever be operated safely on the same trackage at the same time'. (*Ibid.*, p. 42528)

New Zealand

New Zealand, like Great Britain, has brought economic and safety regulation under a single administration—Land Transport New Zealand. The 2004 Transport Regulation Act merged the activities of Transfund and the Land Transport Safety Authority. Transfund had been responsible for managing the public funding of land transport and the track access charges of the infrastructure manager, ONTRACK.

The Land Transport Safety Authority had been responsible for rail safety oversight.

Under the Railways Act 2005, The Director of Land Transport in this administration licenses '…a wider range of railway industry participants' and approves their rail licence holders' safety systems (NZ Government 2005, p. 8). Incident investigation is undertaken by the (aviation, marine and rail) independent Transport Accident Investigation Commission.

New Zealand has restructured its rail regulatory oversight in a similar way to the above-mentioned European countries. In 2004, the railway was vertically separated into Toll NZ (the train operator) and ONTRACK (which is the trading name for the New Zealand Railways Corporation, the infrastructure manager). The rail infrastructure in Auckland was repurchased by the central government in 2001 and urban passenger services on that part of ONTRACK are provided by Connex New Zealand. By contrast with Europe, however, mandated access is passive: Toll NZ has exclusive use of a given line segment unless its traffic falls below 70 percent of the average of traffic moved between 2002 and 2004 (New Zealand Treasury 2004).

Relevance of overseas experiences for Australia's regulatory structure

As discussed earlier, some industry participants have called for a change to Australia's railway regulatory structure. In particular, the participants seek a single safety regulator:

> The Booz Allen study [BAH 1999] was conducted last year and it consulted widely with industry—in fact, there were some industry members on that panel. The resounding view from industry was that it wanted a single regulatory framework with a single regulator. It did not want to go from 20 to seven safe working systems; it did not want to deal with seven harmonised accrediting authorities. It wanted to deal with one regulator and one set of systems. (Robert Jeremy, then Commercial Director of Toll Holdings, speaking to House of Representatives Standing Committee on Communications, Transport & the Arts 2000, p. 23)

This view is not inconsistent with diverse regulatory application. As noted earlier, the urban rail scenes, in particular, have very different operational and physical requirement and risk levels from other rail tasks. However, a single national safety regulator could accommodate this diversity—as is illustrated in the United States regulations. Here, the interfaces are clear, with federal jurisdiction taking precedence over States and with clearly-defined boundaries on those interfaces. The arrangements in the United States, and the other reviewed countries, are summarised in Table 4.7.

We note that, by contrast with Australia—NSW and Victoria excepting—Member States in the European Union are required to have functional independence between their safety regulation and incident investigation roles.[199] While such a separation leads to additional interfaces though (by contrast with jurisdictional separation), it is arguably necessary separation for unbiased investigations.

While the Canadian rail safety regulatory structure in a federal system results in similarities, there is one important difference. Like Australia, Canada has a federal system and there is recognition of the need for regulatory consistency across jurisdictions. Further, Canada's safety regulation is nationally-based and, like Australia, provinces retain regulatory control of some railways. Also, like Australia, the Canadian governments recognise the value of optimising consistency in rail safety regulations. However, where the two countries differ is that Canada has federal rail safety regulations; these apply to most of the railway network and the regulator reformers seek to bring the provinces' regulations into line with these federal regulations. Thus here, the nature of regulations is defined and the direction of transposition of the regulations (from federal to provincial government) is clear. Australia, by contrast, does not have a national regulatory system from which to set benchmark safety systems—although the proposed Model Legislation works on this principle—and so the process and direction of transposition is unclear.

The Canadian approach also recognises that the dynamics of safety regulation mean that the transposition of federal regulations into provincial safety systems needs to be automatic if consistency is to

199 Under Article 21 of Directive 2004/49/EC. See European Parliament 2004a, p. L 220/28.

4.7 Regulatory systems, by country*

	Great Britain	*Denmark*	*Sweden*	*Canada*	*USA*	*New Zealand*
Mandated access regulator	Office of Rail Regulation	National Rail Authority	Swedish Rail Agency	-	-	Land Transport New Zealand
Economic Regulator *	Office of Rail Regulation	National Rail Authority	Swedish Rail Agency	Canadian Trans-portation Agency	Department of Transport—Surface Transportation Board	Land Transport New Zealand
Safety Regulator *	Office of Rail Regulation	National Rail Authority	Swedish Rail Agency	Transport Canada	Department of Transport—Federal Railroad Administration	Land Transport New Zealand
Urban railway safety oversight	Office of Rail Regulation	National Rail Authority	Swedish Rail Agency	Transport Canada is regulator when track owner is federally-regulated	Federal Railroad Administration for all railways connected to national network or cross highways	Land Transport New Zealand
Accident investigation	Rail Accident Investigation Branch †	Danish Accident Investigation Board	Swedish Accident Investigation Board	Transport-ation Safety Board of Canada	National Transportation Safety Board	Transport Accident Investigation Commission
Interface mechanism for other safety regulations	Railway Enforcing Authority Regulations					
Mechanism for transposing federal regulations	Central government regulations	Central government regulations	Central government regulations	Depends on province	Federal regulations	Central government regulations

Note: *The shaded entries show where countries have single economic and safety regulation.

† The Branch is part of the Department for Transport but is functionally independent, with the Chief Inspector reporting directly to the Secretary of State.

be maintained across the jurisdictions. The provinces have adopted one of three models for transposing federal regulations into provincial safety systems. The federal-provincial regulations only retain consistency where the province has adopted the delegation model. Elsewhere, because regulations are not automatically updated into the provincial system, regulatory gaps arise between the federal and provincial systems. The Canadian experiences with the efficacy of the transposing process has relevance for Australia's National Model Legislation that is planned for 2005–06; when the Legislation is endorsed by a majority of Australian governments' Transport Ministers, the intention is to transpose the principles of the legislation into each government's regulatory framework.

Canadian experiences also illustrate that the co-regulatory system with performance-based standards involves additional interfaces but the federal-provincial system results in increasing complexity. Canada has changed its federal safety regulation principles, leading to devolution (co-regulation) and performance standards of much responsibility to railways. This regulatory process inevitably leads to additional communication flows as the number of interfaces increases and it has been noted that as a result this matrix of companies and the rules that the companies adhere to becomes more complex (FPWG 2001, p. 12); this is especially relevant in the context of the additional series of provincial regulator interfaces. Thus, what is important for Australia, however, is to note the difficulties encountered in Canada with maintaining the consistency of provincial regulations with the federal regulation. To the extent that the change in federal regulations flowing from these new principles did not flow into provincial regulations, it has led to increasing inconsistency in regulations.

European regulatory structures also have relevance for Australia in that, like Australia, they include access/economic regulation as well as safety regulation. The recent reforms to regulatory oversight in Britain, Denmark and Sweden provide additional insights, albeit that their train and track operators are heavily subsidised. The reforms also raise the issue as to whether regulatory oversight of safety and access issues should be considered by a single, or multi-functional, regulator.

The adoption of a single access/economic and safety regulator has implications for ensuring that the regulator has to confront directly the implications of its safety rulings on operator viability and vice versa. Arguably, this is even more important in the Australian context than Europe to the extent that most Australian freight operations are private companies. As Gómez-Ibáñez warns, '…it is important to choose the regulatory scheme carefully if private infrastructure is to survive'. (Gómez-Ibáñez 2003, p. 17)

However, this view is not supported by Britain's Health & Safety Executive (HSE), which argues that:

> If safety regulation formed part of any body that made decisions about funding and/or economic regulation, there would be a real risk that there would be a public perception, whether justified or not, that safety would be compromised in economic decisions with safety dimensions. The existing arrangements are transparent and allow the economic regulator to fulfil his legal obligation to seek independent advice from the safety regulator. This does not mean that the safety regulator should be free to demand safety at any cost. Consideration of costs is a fundamental part of HSE's approach to encourage sensible and proportionate management of risks, as enshrined in HSWA[200] by the 'reasonable practicability' test, and decisions about new regulatory requirements are made by Ministers on the basis of Regulatory Impact Assessments on which industry is consulted. (HSE 2004, pp. 1–2)

We should also note that the British approach is at odds with other regulatory structures. Gómez-Ibáñez notes that:

> In most countries, the regulators in charge of safety and environmental concerns are separate from those responsible for controlling monopoly. The separation is designed to avoid any potential conflict of interest between setting tariffs and setting health and safety standards. (Gómez-Ibáñez 2003, p. 6)

There is another related risk in this multi-functional regulatory structure. As noted earlier, because safety co-regulation involves a degree of discretion, there is a higher risk of regulatory capture. In this context, while a multi-functional regulator can generate

200 Health & Safety at Work etc Act.

regulatory consistency, the range of special interest groups that it faces will be greater. Thus, the likelihood of regulatory capture will be greater.

Offsetting this risk is the potential for consistency in economic, access and safety regulation. For instance, explicit rail safety regulation derives from mandated access issues so safety and access regulations can be pursued with greater consistency. These are the two regulatory areas which the Danish, Swedish and European Union have combined.

This regulatory structure has been adopted in these European governments despite the relatively greater range and magnitude of risks that they face. It is also the case that Australia's railway industry is relatively small, and has a relatively modest degree of economic regulation, compared with the British industry. These factors should make it relatively easy to adopt a single, multi-functional regulatory structure. British operational diversity is greater, and has potentially far greater risk consequences, than Australia.[201] The size of the Australian railway industry for safety purposes—defined in the number of trains, the number of lines, passengers and railway junctions—is not large by comparison with Britain. This is despite the fact that the tonnage and tonne-km task is very substantial—and much greater than in Britain—and the urban passenger task is significant.[202] Great Britain has devolved governments—Wales and Scotland—and locally—funded rail services, such as in Strathclyde, London, the West Midlands and Greater Manchester. Despite this, the regulatory oversight remains in Westminster and, indeed, now resides in one regulatory entity.[203]

201 For instance, Intercity trains regularly operate at 200 km/hr, double the highest speed regularly set in Australia; the intensity of its predominantly-passenger operations varies from a few trains an hour in remote rural areas (as in Australia) to 18 or more trains (of 500 or more passengers) each way per hour for a given double track (in London).

202 National Rail (NR) recorded 976 million passenger journeys and London Underground (LUL) recorded 948 million passenger journeys in 2002/03; in NSW in 2003 there were 277 million passenger journeys and 508 million for Australia in total. NR passenger kilometres were 39.7 billion, LUL's were 7.3 billion compared with 8.3 billion for all urban rail in Australia and 2.4 billion for non-urban rail (DFT 2005, table 6.1; ATSB website, ARA 2004, p. 8).

203 Note that under the devolution Acts for Scotland and Wales, safety is a 'reserved matter' in that the UK government in Westminster is responsible for its regulation.

British and European Union reforms therefore lead us to review our regulatory structure. If the regulatory impact, relative to the regulatory objectives, is to be considered, we must ask whether or not the net effect of having multiple regulators and jurisdictions is to undermine the viability of railway operations. Furthermore, multiple regulation brings increased complexity, dilutes management attention on pro-active safety measures and requires additional training and communication.

Conclusions and regulatory options

The railway industry in Australia has changed significantly in the last decade. The changes include corporatisation, privatisation, extensive contracting, vertical separation, mandated access and a marked increase in cross-jurisdiction train operation. The final change is a very belated echo of the trend of rising cross-border freight (bridging) flows. The policy changes have been underpinned by new State-based access, economic and safety regulations.

The growing cross-jurisdictional movements have, however, highlighted the differences in physical standards and operational practices as well as the regulatory diversity and the growth in regulatory interfaces. Thus, at a time of increasing bridging flows there have also been rising bridging costs. Policy makers recognised the need to remove barriers to freight movements across borders and, for instance, this was the basis for the establishment of National Rail Corporation in 1991. (See, for instance, Affleck 2002a, for a discussion of the corporation's genesis.) Despite this, however, the regulatory trend has been to expand duplication and differentiation in standards.

There is no reason for a single appropriate physical standard or operational standard-customisation factors can outweigh standardisation factors. Similarly, terms of access need to be customised to reflect, in particular, the commercial viability, industry regulation (such as whether the railway is vertically separated or integrated) or ownership of the railway. But such terms should not merely reflect the prevailing philosophy of a specific jurisdiction. In a similar vein, safety oversight varies with the degree of safety risk and the consequences of safety failures. This reflects particularly the nature of operation, whether it is passenger or freight; and the intensity of operation—especially heavy-haul ore/coal movements or branch line grain movements.

Nonetheless, it is undeniable that the interface between operations with different risk profiles can provide significant regulatory challenges. For instance, 'low' rolling stock standards for light rail (that is, trams) in the United States leads the FRA to conclude that considerable additional safety systems would be required in order to permit such vehicles to operate on or alongside the (higher-specification) heavy rail network to ensure that the interface between the two operations is carefully managed to keep the two types of vehicle physically separated.

Operational standards vary to reflect the associated risks. The physical standard often reflects the terrain, the prevailing market and the cost-benefit of undertaking investments that would harmonise those standards. Similarly, in the absence of revenue from access charges recovering all long-run costs, or due to the economics of specific freight operations, efficient access charges are often market-based and will therefore vary by route and operation.

Consequently, efficient regulations will not and should not converge to single standards or access charges—there is a limit to the degree of harmonisation that should be pursued. Nonetheless, for optimality the diversity in regulatory oversight needs to vary by factors such as safety risk, traffic and competition and not to vary by jurisdiction.

Is regulatory fragmentation a significant 'burden' on industry players?

Diversity in charges and systems does not mean that multiple regulatory agencies need to be built around this diversity. In recent years much attention has focused on the number of regulators faced by rail industry players. Various media reports have highlighted the apparently large number of regulators relative to the number of train operators.[204] To some extent the rail industry shares this multiple regulation with other industries. All firms face separate OH&S, workers' compensation, environmental and industrial relations conditions and regulations for each jurisdiction in which they operate.

204 See, for instance, *The Daily Telegraph*, 24 November 2003, 'Leave the nation's rail freight to us: Corrigan'.

Further, as with rail safety regulations, the compliance auditing undertaken by one jurisdiction may not preclude an audit being required by another jurisdiction.

However, it seems that national train operators face more multiple generic and rail industry regulations than most other industry players. This high incidence arises because of the extent-relative to most other businesses—to which rail freight and interstate passenger movements extend over jurisdictional borders. Given the mobile nature of the business, train operators cannot operate as the quasi-independent 'silos' of operation that are possible for other multi-jurisdictional businesses.

While it is easy to recognise the multiplicity, it is difficult to quantify the burden of the regulatory overlays faced by rail firms—particularly when it involves scarce, intangible management resources. The resources required for safety oversight and safety strategy are not easy to replicate or delegate. Consequently, duplicated and unnecessarily diverse regulations will inevitably dilute senior management focus from the very safety task that the regulation seeks to improve. Pacific National illustrates the impacts, which we classify as follows:

- **opportunity costs**—the 'excessive' level of regulatory detail leaves little time for proactive thinking. Presumably this would be essential, in particular, with safety-related management;
- **management resources for compliance—**regulatory compliance necessarily consumes a deep pool of professional expertise and consultant support. However, extra resources are needed for sorting out jurisdictional variations and the requirements of different regimes;
- **resources for regulatory consistency**—effort is required to negotiate consistent regulations; and
- **training and auditing resources**—the company points to additional resources required for training and meeting the needs of the different auditors (Pacific National 2003, pp. 7–8).

In some areas there will be limits to what can be achieved by reducing the number of regulatory interfaces. Under co-regulation, accreditation processing is necessarily based on individuals' interpretations. Consequently, it may be difficult to apply consistency, whether the system has a State-based or national regulation with a single national office. That said, there will be greater consistency when regulatory authorities are 'singing from the same hymn sheet, with an eye to the same conductor'. This is pertinent, in particular, in areas of operational safety.

However, as noted by NERA (2000, p. 82), there are differing philosophies to, and tolerances of, safety risks. So it should not be surprising that achieving harmonisation in safety is difficult—'...imposing one party's views on "safety" on other parties is likely to be more difficult than dealing with less emotive issues of engineering, performance and cost'. (NERA 2000. p. 94)

This problem is evident from the experiences with the Regulators' Panel and earlier safety coordination efforts, where State-based regulatory control has tended to diverge as well as converge.[205] In this context, the regulatory system is inherently unstable. ARTC's Chief Executive, David Marchant, noted (in 2000) that:

> ...in the rail industry the rules can change from one place to another overnight. The safety regime can change in one state practically instantaneously overnight and add a fortune to your risk or more. (House of Representatives Standing Committee on Communications, Transport and the Arts 2000, p. CTA 66).[206]

Specific drivers for change here are the urban passenger railway islands, with the independent jurisdictional safety decisions that are

205 A recent example of unilateral decision-making was the decision by RailCorp to investigate train speed monitoring (and possibly enforcing) for trains in the RailCorp area (while recognising that the impetus here is from the railway company rather than the regulator). (The Australian 2004)

206 Earlier in the proceedings, Mr Marchant referred to the special commission of inquiry into a (then) recent accident in the Blue Mountains [presumably, at Glenbrook] that recommended a new (different) regulatory model for NSW, replacing the co-regulatory model. Mr Marchant then noted:

> But what I am worried about is the situation where, in the absence of coming to a coherent framework nationally-and I thought there was one-it is very likely that, on the cusp of getting some sort of national codes and coregulation model, just when we were about to get there after five or six years of very hard work by people in the industry, a reaction to a particular event is likely to establish a new regulatory regime in at least one state that, in fact, throws out all the framework that came to fruition through a coregulatory model. (House of Representatives Standing Committee on Communications, Transport and the Arts 2000, p. CTA 25).

made in those islands; these impact (in particular) on the freight bridging that cross enter those islands.

This means that rail industry players need to constantly apply resources to both negotiate consistency and fight to maintain that consistency. For example, in its submission to the Productivity Commission inquiry into national competition policy, Pacific National highlighted the extent of the efforts needed to establish a national health assessments standard (Pacific National 2004, p. 6). Pacific National also notes that the Victorian initiative preceded and pre-empted the establishment of the NTC national standard, gazetted in December 2003. Within days of the commission establishing its national standard in May 2004, New South Wales had adopted the Victorian standard and gazetted their own standard. Further, in July 2004 the Victorian Department of Infrastructure released an issues paper on rail safety regulatory options for that State.[207] Thus resources are required to seek to address and redress this multiplicity. It would seem that as long as the regulatory structure is based on multiple regulators, rail firms will need to devote resources to seeking to achieve and maintain that consistency.

To summarise, it is appropriate for the regulatory process to be conducted with case-by-case assessments of access charges and risk/safety management. However, the industry also faces a high degree of multiple regulation, the merits of which are much less clear. This is an inherent limit to the opportunities to harmonise jurisdictional oversight through prescription. One-stop-shop and mutual recognition principles can ease the jurisdictional inconsistencies in situations where it should be possible to have consistency. Nonetheless, each regulator inevitably has its own guiding ethos that influences the regulatory application.

Thus, the fundamental issues are that harmonisation is difficult to achieve and to maintain; and that, for such a small industry (in terms of the number of players), whether the extra resources required for maintaining multiple regulatory systems can bring benefits that

207 The Department of Infrastructure is, however, to some extent aware of the need for a national approach: 'Development or review may usefully be initiated by industry or the Safety Regulator. However, in most cases they should be approached from a national perspective to support the objective of national harmonisation'. (Department of Infrastructure 2004, p. 65)

outweigh the costs of the system. Inevitably, as we observe with most States' safety regulation and investigation functions being under one regulatory organisation, significant compromises are inevitable if the jurisdiction is to maintain a practical presence in overseeing both functions (with incident investigation fortunately being an irregular, though large, use of investigation resources). Separation of investigation from regulation would increase further the interfaces in the industry—such additional interfaces would be significantly reduced if regulation and investigation was overseen at a national level.

What is the burden arising from this system? We considered earlier the costs and benefits of the existing regulatory structure. In the United States, the FRA's Railroad Safety Advisory Committee sets a principle that safety regulations should '…impose as small a burden as is practicable' (RSAC 2004) while Savage argues that the '…monitoring and enforcement strategy achieves compliance at the minimum cost to the government and the firms that are regulated'. (Savage 1998, p. 149) Nonetheless, we concur with NERA's view that it is not possible to produce quantitative estimates of benefits of harmonisation. (NERA 2000, p. 101) Despite this, it is intuitive that the burden imposed by non-harmonised/multiple regulation is greater than could be achieved through streamlined regulatory structures that remove several regulatory interfaces. This latter scenario ensures harmonisation as there is (for instance) only one safety regulator. Undoubtedly this will reduce transaction, coordination and opportunity costs associated with regulations—and such structures may well achieve that with enhanced access, economic and safety regulatory outcomes.

Options for regulatory oversight

If the current multi-regulator structure is unlikely to achieve a harmonised solution and, in any case imposes burdens on industry players through multiple interfaces, what alternative structures could be considered? In 2004, the NTC investigated enhancing the co-regulatory systems. (NTC 2004b) This resulted in the development and implementation of the National Rail Safety Legislation—a single regulatory approach that would be transposed through identical legislation in each State. These measures remain framed around the existing multiple regulators—access, economic and safety—and multi-jurisdictional regulators, with enhancements to one-stop-shop access and mutual recognition. Alternative options for regulatory oversight could include the following—notwithstanding the need, in all cases, for separation of incident investigation from safety regulation:

- a national access and economic regulator and a single jurisdictional safety regulator;
- a national access and economic regulator and a national non-urban safety regulator and a national urban safety regulator; or
- a national industry-specific regulator, covering access, economic and safety regulation.

The following sections discuss these options. It is important to note that, as these options are derived from overseas examples, the scope to apply them in Australia may be tempered by differences in constitutional and governmental arrangements.

Functional national safety and access regulators

Maintaining multi-jurisdictional regulation does not minimise the regulatory burden on industry players. For the relatively small industry size, the multi-jurisdictional structure also leads to compromises—such as where safety regulation and investigation are under the same management. Are there alternatives for achieving consistency and lowering transaction costs? One option is to have a single regulator for each function, namely a single regulator for safety and a single regulator for access. Such a structure would provide a practical critical mass that would enable safety regulation to be divorced from incident investigation.

Smith and Shin note that a national regulator can still involve other jurisdictions in the regulatory process. They see a few ways that this can occur:

- policy is set by the national tier and implemented by the lower tier. (This is the spirit of the Canadian approach: provinces are consulted on regulatory changes and federal regulations are instituted; there is a varying effectiveness of the approach that depends on which model is used to transpose the regulations into provincial oversight);

- division of different regulatory tasks—a firm may be subject to different aspects of regulation at different tiers which places a premium on mechanisms to coordinate the regulatory requirements. To a very small degree, North American safety regulation follows this approach, notably with activities such as oversight of level crossings occurring at the local level—but with virtually all other safety regulation occurring at the federal level; or
- formal responsibilities are assigned to different tiers or those tiers are financially induced to pursue national policies (Ibid., pp. 56–57).

Where local oversight is retained, as in safety regulation with some Canadian provinces, the application of safety oversight retains the common national approach to regulation. The local regulator ensures that local issues can be considered effectively. Some would argue, however, that such local issues can be considered as effectively from a single national body as from a devolved body.

There is industry support for this single regulatory structure. ARTC expressed concern with 'unwarranted differences' between individual access arrangements across access regimes. It advocates a single national access regulator that would ensure replication of desirable access arrangements across different access regimes. It envisages that the regulator—and they propose that it would be ACCC—would be multi-sectoral. The corporation suggests that this would ensure consistency in access arrangements across sectors and industries. (ARTC 2004, p. 14)

National access/economic regulator and urban/non-urban safety regulators

We have noted that safety accreditation is tailored to the range of risks associated with the type of operation and intensity of operation. Thus, we considered, in Chapter 4, that the network could be broadly categorised into urban passenger operations and non-urban freight, reflecting the broad safety risks. The risks and the public welfare interests associated with urban operations are undoubtedly considerably greater than those associated with freight in non-urban areas.

We could adopt a regulatory structure that reflects this risk dichotomy, with a single non-urban safety regulatory system and a single urban safety regulatory system that would embrace the mainland capital city urban passenger train islands in the national railway network. This option would provide a national approach to urban train operation that would ensure that the interfaces with the non-urban operations would be managed consistently. The approach would recognise the heightened public welfare interests for urban passenger operations.

Nonetheless, given that the approach would lead to additional regulatory interfaces (relative to a single national safety regulator), it is appropriate to ask why this approach has not proven necessary in the United States, where it is common to have interfaces between urban passenger islands and intercity freight.

National railway industry regulator

Smith and Shin (1995, p. 56) observe that the optimal regulatory balance between the jurisdictions depends on the industry characteristics, the jurisdictional units and the regulatory issue(s) being considered.

British, and some continental European, railway regulation has evolved towards a single national railway regulator, incorporating safety and access/pricing functions – see Table 4.7. The motivation for the British to widen the breadth of their single rail regulator was to ensure consistency across the regulatory issues. Similarly, setting a single national regulatory system facilitates consistent national treatment of a national business where improving harmonisation is regarded as an important objective.

Consistency can be pursued by having a single rail regulator covering a range of functions—notably, access, pricing and safety. The European Railway Agency was established in 2004 to institute a common framework in these functions, backed by the force of Directives (European Parliament legislation).

Like Australia, Great Britain has a considerable diversity in operating environments and infrastructure standards; this has not required the establishment of multiple regulators for different operating areas or jurisdictions. However, the varying technical standards inevitably lead to specific rules and conditions for given circumstances. Indeed, the government now has a single regulator for rail safety, economic and access. In 2004, the British government established the Office of Rail Regulation and has added the safety regulation function to its access and economic regulatory functions. The aim of combining these tasks under the one regulatory body was to achieve consistency between the regulated parameters. Rail safety oversight was transferred from the Health & Safety Commission despite the views of its management. Its Chair commented that:

> It is our firm belief that safety regulation should be independent of its industry and that any regulator should have teeth to be able to enforce measures where necessary. (HSC 2004)

The case for a single industry regulator (rather than, particularly, separate access and safety regulators) is therefore mixed. Nonetheless, this option, and the option for single, functional regulatory oversight, offers ways of reducing the regulatory burdens and the number of interfaces. Application of the regulations by devolved jurisdictional offices may arguably ensure that local issues are fully considered.

Chapter 5

Conclusions

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This report addresses the principles of government intervention in optimising rail harmonisation. In doing so, it reviews the two key areas of optimal harmonisation in technical standards and regulations. Key considerations and conclusions follow.

Principles of government intervention

We take, as a first assumption, that where there is financial gain from doing so, industry players are likely to optimise the balance between standardised and customised technical specifications. However, if commercial interests are relatively muted, standardisation may be sub-optimal. Thus, the development of multiple standards, such as multiple rail gauges, has also arisen for non-financial factors. One of the most notable of these is that, historically, the railways' operation was overseen by non-commercial government departments or commercial departments that were subject to strong political influence.

Reforms in recent years have substantially changed this environment. Commercialisation and/or privatisation of railways have brought about much greater market forces to the industry—but also greater regulatory oversight. Will the market environment bring about optimal technical standards? In the United States, railways were constructed to nine major railway gauges. There, negotiation and persuasive rules on inter-system traffic ensured that market pressures brought about the conversion of the gauges to a common standard.

However, the market's ability to optimise standards can be limited by three important factors. First, if there are many industry players, it can be more difficult to achieve consensus. However, in Australia's railway industry this is unlikely to be a major issue in that there are relatively few players.

As a related issue, optimisation may be difficult to achieve if the standard-setting and adoption leads to costs and benefits falling unevenly on different industry players. This makes it more difficult to negotiate a redistribution of costs and benefits.

Finally, there may not be a commercial case for harmonisation. The market's ability to optimise technical standards can be inhibited to the extent that there is often insufficient traffic and/or revenue to warrant the investment to standardise a given technical specification. In this case, while a common standard may be seen as desirable, optimisation requires that the rail firm adopts the specification only when the equipment is renewed. Australia's private sector rail firms have acquired long-lived railway assets set to a range of different standards. The return on these assets is often insufficient to cover their long-run economic costs. As a result, retaining much of the system in the long-term is of questionable value let alone financing harmonisation.

Achieving technical harmonisation can be impeded by the high level of investment that is required. Partial harmonisation does not always remedy the inconsistent standards. This means that often there is no immediate financial return on individual projects. The benefit accrues only after several individual projects have been completed. An example of this is expanding the infrastructure loading outline by raising the height of one bridge. This could be done to enable the double-stacking of containers. But it will not bring any financial return until all other bridges on the railway route have also been raised to the same height.

Will optimal harmonisation occur when there are adequate financial returns? The United States experience suggests that this is likely. Although the United States' first (private) railways adopted an array of standards, they soon recognised the benefits from a large degree of consistency. This was because, almost from the outset, railways linked up and operators sought to interchange trains—and freight more generally—across the railway systems. They agreed to common technical standards where wagons or trains were interchanged across different railway company systems. As a result, United States railways converged to broadly consistent physical and operational standards from an early time.

As a general point, complete standardisation of systems is not necessarily required. Compatibility, through a common interface, can be more important than a harmonised system. This is particularly relevant where the cost of bridging devices between different standards is low. In the case of railway gauge, however, no system of goods transfer, regauging of wheels or bogie exchange system has proved to be a low-cost option. The railway gauge costs of conversion or bridging do represent an extreme example of standardisation or bridging costs. The consequences of market failure, then, may often be considerably less than those that have arisen with gauge.

As early railway experiences in the United States illustrate, however, the market can still fail to set or adopt standards. The gauge example shows that the consequences can be substantial.

Is there a role for government in achieving optimal harmonisation? We should preface this by considering both regulatory and technical harmonisation. In the case of regulatory harmonisation, 'the ball is in government's court' as it is up to government to resolve such inconsistencies through negotiation or removing duplication. Particularly for railways, the costs of regulatory disharmony that occur at the interfaces between the regulatory systems can be significant because of the considerable bridging traffic across those interfaces. However, removing such disharmony can, in principle at least, be achieved at relatively little cost. Put another way, the benefits of regulatory harmonisation will outweigh the costs. Government should therefore pursue regulatory harmonisation.

In principle, government can legislate to enforce technical standards. However, government has no inherent advantage over market players in identifying appropriate standards or establishing the balance between standardisation and customisation. Government enforcement may thus lead to an inferior outcome that is less optimal than no intervention. However, government can be constructive by coordinating and facilitating industry-led leadership on harmonisation matters. This has been illustrated in Australian railways through the facilitation role of the Australian Government and other agencies (such as the National Transport Commission).

We should note, in any case, that the consequences arising from enforcing inappropriate standards are high in the Australian railway industry. Railway industry players' long-term returns on investment are typically very slender so the consequence of inappropriate government intervention is very significant.

Thus, given the characteristics of market imperfection and market failure in this network industry, it suggests the likelihood that commercial pressures in the industry to bring about optimal harmonisation will be relatively strong. Thus, the appropriate governments' role in the rail standard-setting should focus on facilitation and coordination rather than standard-setting and enforcement.

Technical harmonisation

The completion in 1995 of the Wentworth Plan meant that the mainland State capitals were, for the first time, linked by a common railway gauge. However, the network has other areas of diversity. For instance, it has different train capacity standards (such as loading outline, axle loads and trailing load), while track capacity standards (such as length and frequency of passing loops) vary considerably. Further, the network has different, incompatible, safeworking systems, with different ways of communicating instructions to drivers, different authorities to proceed and different ways for signallers to establish train locations. Communication systems are similarly inconsistent.

Some technical diversity may be justified in different circumstances. The development of the diversity can reflect the application of technical standards that are fit-for-purpose—given varying types of terrain and varying levels and types of traffic, it may be more appropriate to have the infrastructure customised to particular situations rather than set to a uniform standard. That said, the development of technical diversity also reflects historically disjointed and uncoordinated decision-making by State-based management. It also reflects the temporal uptake of differing technology that was state-of-the-art at the time of the investment, being subsequently superseded by technological advances.

Nonetheless, it is possible to conclude that the range of safeworking and communications is excessive, if only because similar traffic and operational environments across the system have different solutions, when we would expect similar approaches.

What has failed in Australia is in the adoption of different technical systems that can be bridged at low cost. For instance, where geographical and operational environments do differ and technical standards vary accordingly, low-cost bridging devices can enable different standards to be adopted. However, in a number of cases, different systems have been adopted without practical interfaces. For instance, inconsistent and incompatible communications systems have been adopted. This has led to high bridging costs, such as additional staff training and equipment. In recent years, the rising bridging flows across these disparate systems have increased the overall bridging costs.

The persistence of suboptimal standardisation in railways often arises because of the long economic life of the assets. The typically-low financial returns from railways mean it is often not cost effective to invest in standardising. Opportunities to achieve greater optimisation of harmonisation must typically wait for the more general requirement for asset renewal. At that time, the incremental costs of standardisation can be relatively low.

The development of a common management of most of the interstate network should ensure that, as the business case for replacement of the systems comes about, the new systems should be to a common standard or compatible (through protocol standards).

Regulatory harmonisation

Regulatory costs rise when the regulations are not consistent. However, regulations need to be customised to reflect the environment in which they are applied. It is optimal to have customised regulatory systems just as it is optimal to have customised technical specifications. Safety and access regulation needs to be customised to reflect the diverse ownership, industry structure, traffic and operational environment. For instance, it is inevitable that safety regulation will require higher safeguards in urban areas where safety incidents are more likely to arise (due to higher population density and passenger-train interactions) than in rural areas. Similarly, geographical and financial environments colour the way that train operating rules and access regimes, respectively, are framed. The differing operational risks and terrain mean there will necessarily be different forms of regulatory application on different parts of the system.

The impact of physical and regulatory diversity depends on the extent to which there are flows across the relevant physical and regulatory 'break-of-gauge' interfaces. For the railway industry, the number of interfaces increased just as traffic levels rose across those interfaces. Non-optimal diversity in physical and regulatory systems has similar adverse impacts on the industry.

However, an important difference between regulatory and physical harmonisation is that often there are low financial returns on avoidable physical investments in standardisation whereas the regulatory costs of resolving disharmony are relatively low and the benefits are potentially very significant. However, to the extent that considerable resources are required to seek and maintain consistency across jurisdictions—implying that the regulatory framework is inherently unstable—the conclusion must be that optimal regulatory harmonisation requires the removal of the duplicated and overlapping regulatory systems.

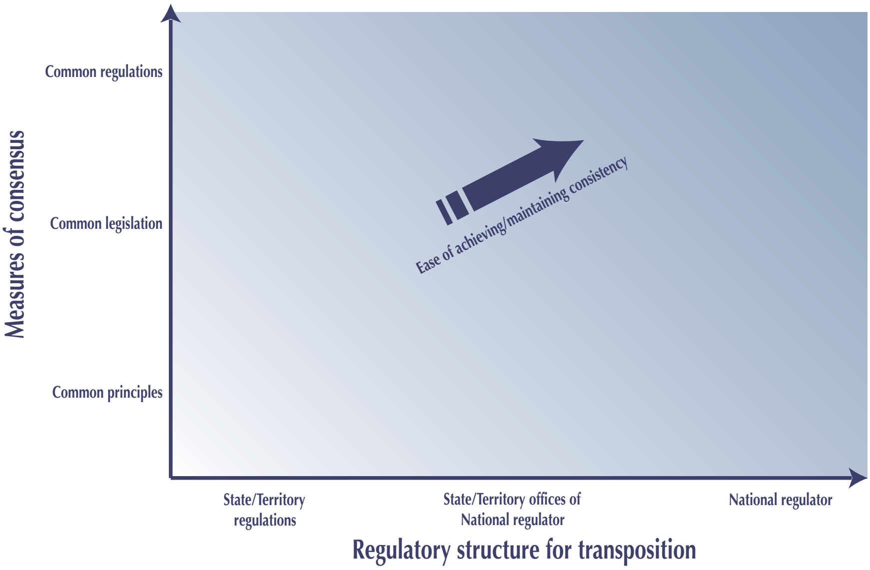
In the last decade, individual jurisdictions have introduced externally-imposed industry-specific safety, pricing and access regulation into the railway industry, in addition to OH&S regulations. The result has been multiple access regimes and overlapping regulatory bodies.

A feature of railway reforms has been the increase in number of industry entities and consequent increase in industry organisational complexity. It is important to recognise that as each industry player is added, the number of interfaces is multiplied rather than added. The concern here arises because this complexity also occurs with regulatory entities: as industry players increasingly operate across jurisdictions (the bridging flows increase), the greater the transaction and coordination costs that arise with interactions between regulator and industry player.

Where similar conditions do prevail, however, it would be reasonable to assume that regulatory consistency is desirable and should occur. Achieving and maintaining consistency should not be underestimated, however. For instance, despite jurisdictions' undertaking to establish and maintain safety regulation consistency when external safety regulation was introduced from in the 1990s, this has not been achieved.

In Figure 5.1 we present a schematic illustration of the environment for achieving and maintaining consistency in safety regulations. It is recognised that, due to the need for interpretation of regulations (particularly with a co-regulatory environment), there would even be the potential for inconsistency where there were State/Territory offices of a national regulator. The environment for achieving and maintaining consistency is inevitably strongest where there is a national regulator with a common regulatory framework.

5.1 Environment for achieving and maintaining consistency in safety regulations



By its very nature, it is particularly difficult to achieve and maintain safety consistency when pursuing a co-regulatory model. This model works on the plausible basis that safety is best managed by the entity that is in the best position to manage the risk. For this reason, much of the risk management occurs at the train operator and infrastructure manager level, using railway rules and codes of practice to define operating systems. But because of the imprecise nature of the boundary between each railway entity and regulator, there is inevitably a judgement required by the regulator and this will differ across regulators.

So it is not surprising that Australian safety regulation varies across jurisdictions. Even in Canada, where provinces' regulations are essentially transposed from federal regulations, the governments recognise the difficulty in ensuring that (as federal regulations change) there is consistency across regulatory systems. (We should note, however, that at least in the Canadian system, the direction of the transposition is clear.) So there can be a major task in achieving as well as maintaining consistency in regulations.

Because some regulatory boundaries are ill-defined and inconsistent, there is a need to ensure that the potential for regulatory overlap and regulatory gaps are well-managed. In Australia, the OH&S and railway safety regulatory systems have overlap, and the degree of overlap varies across jurisdictions. In Great Britain, the reforms being introduced during 2005–06 will manage that overlap, explicitly ceding responsibility for safety oversight to one entity. In Canada, the issue of safety regulatory gaps is recognised and efforts have been made to ensure that the federal regulations prevail.

An important safety regulatory boundary exists in urban areas. Here, there are relatively high safety risks due to the intensity of train operation, the nature of train operation (with frequent stops) and the immediacy of passengers and human activity on the railway and in the immediate vicinity. In this context, in particular, the interaction of urban passenger train operations and inter-urban freight operations, requires relatively high levels of safety vigilance. In the past, the integrated railway operator managed those interfaces for itself but with additional (third-party) entities on the system, the degree of safety management processes must be more formal to deal with the new external interfaces.

In some cases, the urban interface between operations can be difficult to manage—and the United States' Federal Railroad Administration (FRA) and Federal Transit Administration (FTA) express doubts that systems can be developed to allow lightweight light rail vehicles to operate on the same right-of-way as heavy rail vehicles (commuter trains and freight trains). Elsewhere, however, the FRA provides safety regulatory oversight for both passenger and freight operations across the nation; only stand-alone Underground/Subway-style trains that do not directly interface with highways or other railways are excluded from the FRA federal regulations. Even here, the operators are required to submit safety systems that are consistent with FTA principles. Similarly, in Canada, if a provincial train operator uses a federally-regulated railway, the train operating rules must be that of the owner-railway and the safety regulations must be the federal regulations.

The issue of regulatory harmonisation therefore inevitably leads to the option that, to achieve and maintain regulatory consistency (where consistency is desirable), the solution is to remove the regulatory layers. The layers can be seen in two forms:

- horizontally across jurisdictions; and/or
- horizontally across functions (e.g., through merging access and safety regulations).

These options should be seen against the benefits and costs from the current single-functional, multi-jurisdictional regulators. The attribute of multi-functional regulators is that it achieves consistency of regulations (notably, in economic and safety oversight) but it can be argued that it will lead to undue compromise of safety for financial gain.

The benefits of multi-jurisdictional regulation include that multiple regulators introduce alternative approaches to regulation, and this encourages regulatory innovation and improves rigour. However, multi-regulatory systems increase the number of interfaces and opportunity costs are likely to be incurred. For instance, additional senior management resources are required for complying and meeting regulations. This may mean that management is more reactive than proactive—and this has to be of particular concern with safety management. Resource costs are involved for regulators and regulated players in seeking and maintaining consistency. Skill bases are also diluted, the training task is increased; the lack of consistency inevitably has safety consequences. Because of the need to deal with multiple regulators, decision-making processes can be protracted. The additional safety and access processes also raise the cost of new firms entering into the industry or different markets within the industry; this mutes competition between train operators.

Multi-jurisdictional safety oversight inevitably leads to compromises due to the small size of the industry in each jurisdiction: for most jurisdictions, incident investigation appears under the safety regulator's umbrella. Reflecting the fact that an incident may arise due to regulatory failure, it is common practice overseas for incidents to be investigated by independent bodies.

Thus, a conclusion is that while urban passenger islands in Australia represent safety and operational challenges that differ markedly from other parts of the network, the issues are not necessarily insurmountable. Major overseas examples (Canada, United Kingdom, United States), albeit with rather different constitutional backgrounds, point to the ability to adopt single national safety regulatory oversight.

Appendix i

Accreditation plans: example of interface documentation

Lists of interface plans

Document number	*External party*	*Subject matter*
RS-ICP-001	AusBulk Ltd	Intrastate freight services
RS-ICP-002	AusBulk Ltd (Terminals)	Freight services at Port Adelaide/Lincoln/Port Pirie
RS-ICP-003	Gypsum Resources Aust.	Freight services at Kevin and Thevenard
RS-ICP-004	Penrice Soda Products	Freight services at Angaston and
Osborne		
RS-ICP-005	Loongana Lime Pty Ltd	Freight services at Parkeston and Rawlinna (WA)
RS-ICP-006	Freightcorp	Operational systems—Junee
RS-ICP-007	Freightcorp	Operational systems—Parkes
RS-ICP-008	Freightcorp	Operational systems—Cootamundra
RS-ICP-009	Pasminco	Freight services at Port Pirie Tippler siding
RS-ICP-010	EDI Rail	Locomotive and rollingstock maintenance services
RS-ICP-011	ADRail	Management of rail safety during construction of the Alice Springs-Darwin railway
RS-ICP-012	Slingshot Haulage	Freight services at Roe Creek (NT)
RS-ICP-013	BJB Joint Venture	Management of rail safety and maintenance of track and civil infrastructure on the Tarcoola–Alice Springs railway
RS-ICP-014	Onesteel	Management of railway services at Whyalla
RS-ICP-015	Moritz Marine	Freight services and yard access at Tailem Bend
RS-ICP-016	Pacific National Ltd	Freight services at Port Augusta, Port Pirie and Whyalla
RS-ICP-017	INCITEC	Freight services at Port Augusta
RS-ICP-018	Transfield Services	Rail services at Islington Workshops
RS-ICP-019	na	
RS-ICP-020	Port Dock	Freight services at Port Adelaide
RS-ICP-021	RSA	Rail services at Islington Workshops
RS-ICP-022	Bluebird Services	Rail services at Islington Workshops
RS-ICP-023	ARTC Ltd	Network Interface Coordination Plan
RS-ICP-024	TransAdelaide	Procedures for operations on ARTC and ASR railway network' procedures for movements to travel on TransAdelaide's rail network and ASR's rail network
RS-ICP-025	na	
RS-ICP-026	Silverton Rail	Contract railway services—Goobang Junction (NSW)

RS-ICP-027	WestNet Rail	Operations of freight services between Kalgoorlie and Perth (WA)
RS-ICP-028	AWR	Operation of ASR trains at Forrestfield (WA)
RS-ICP-029	Austrack	Operations at Somerton (Vic)
RS-ICP-030	AWR	Emergency/Incident management

Source: Australia Southern Railroad 2003, Rail safety management plan, <http://www.arg.net.au/RS-PLN-001.1%20ASR%20RSMP.pdf>

Appendix ii

Access charging structures and levels

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Rail access charges and structures, by access regime

Regime	*Cost item 1*	*Cost item 2*	*Level of charges*
ARTC regime # (Listed rates are net of GST)	*Flagfall §*	*Variable $/'000 gtk*	Market-based, set within floor–ceiling price band
Line charge:			
1. Adelaide–Parkeston	5 525.29	2.191	
2. Crystal Brook–Broken Hill	650.65	2.477	
3. Port Augusta–Whyalla	128.25	3.871	
4. Adelaide–Pelican Point	39.62	3.445	
5. Adelaide–Melbourne	1529.9	2.519	
6. Tottenham–Albury	479.63	2.205	
7. Melbourne Dock Junc–Footscray Rd	37.23	0	
8. Footscray Rd–Melbourne Port	15.95	0	
Rail Infrastructure Corporation * *GST levy unknown*	*Flagfall*	*Variable $/'000 gtk*	
1. All 'restricted' lines ♣	0	2	Marginal costs
2. Coal lines			
3. Other lines			
QR Network Access ∞ (Listed rates are net of GST)	*Flagfall*	*Variable $/'000 gtk ¨*	
Line charge (standard gauge lines):			
1. NSW/Qld border—Acacia Ridge	130.04	3.03	
2. Acacia Ridge–Fisherman Islands	86.69	4.05	
Line charges (narrow gauge lines)			
3. General lines _	Fixed _	Variable _	
4. Coal lines **	$/gtk maintenance + $/train path + $/ntk allocated cost + $/net tonne + $/electric gtk		Based on 10-year access term; floor and ceiling price band
Babacock & Brown (WestNet Rail)	No structure is specified		Prices set between floor and ceiling band
Australasia Railway ##	-	-	Opportunity cost-based charges and degree of road competition; floor and ceiling
Genesee & Wyoming Australia *	-	Variable rate per gtk	Prices set between floor and ceiling band
Pacific National (Victorian intrastate) ∇			
1. Geelong loop entrance	Fixed fee	Per train fee	
2. Sidings	-	Per tonne fee	
3. Western (standard gauge) grain lines	95% of cost base	5% of cost base, levied per gtk	'cost recovery'; no floor—ceiling price band

Notes

§ Figures presented here are for a 'High' classification of train. This is a train that has a maximum speed of 110 km/h with a maximum axle load of 21 tonnes. The type of trains that meets this description are 'Superfreighters'.

Reference charges as at 1 July 2003. Source: <http://www.artc.com.au/reference.htm>

* Source: Table 1, page 10, Grain Infrastructure Advisory Committee 2004, Report on rail/road options for grain logistics, <http://www.transport.nsw.gov.au/giac/GIAC-Report.pdf>

∝ QR Network Access 2004, Interstate reference access charge (general freight), <www.qr.com.au/track_access/docs/ Interstate_tariffsJan_2004.pdf>

• Note that the variable charge for the 96.6 km NSW/Qld–Acacia Ridge and (approximately) 24.1 km Acacia Ridge–Fisherman Islands lines are presented as charges per gross tonne. Given the fixed nature of the two short links—there is no practical option to using only part of the route—the charges have been converted to a rate per gtk (to make it consistent with ARTC charges).

♣ 'Restricted' lines are lines that are at a performance standard that is not capable of operating modern–standard wagons or main line locomotives. As a consequence, modern wagons can be only partly-loaded and only smaller/lighter branch line locomotives can be used. The condition may reflect the original standard to which the line was built and/or the age of the track and maintenance intensity.

∇ The data here relate to an access charge arbitrated by the Essential Services Commission between Freight Australia and GrainCorp for access to (standard gauge) lines in western Victoria, to sidings between there and Geelong and for trackage in the Geelong environs. See Essential Services Commission 2003, Determination and statement of purpose and reasons on Application for access to Freight Australia's declared freight network by GrainCorp Operations Pty Ltd, RA2/2002, <http://www.esc.vic.gov.au/¬apps/page/user/pdf/¬FinalRailDeterminationAnd¬Statement_PublicVersionOct03.pdf>

The features of the system are:

(a) The cost base is established from ongoing operational costs and new investment—that is, investment subsequent to privatisation of Freight Victoria. An uplift is applied to the costs, to allow for the return on shareholders' funds—although it is unclear what, if any, allowance for risk is made. Costs are based on an assessment of 'efficient' provision of infrastructure.

(b) These costs are then allocated to fixed cost components and variable cost components. The fixed costs comprise 95% of the cost base; the other 5% are allocated as variable charges. This assumed split is generally assumed to be a function of the intensity of usage of infrastructure; high intensity leads to a much higher share of variable costs.

(c) The variable charges are assumed to arise through the gross tonne-kilometres of track usage. The rate per gtk is based on an estimate of the track usage that will generate 5% of the predetermined cost base.

(d) The costs are calculated as annual costs; these are then split in equal twelve-monthly costs. The third-party user pays on a monthly basis, payable in advance; this provides a safeguard to the infrastructure manager (Freight Australia) that exposure to default is reduced.

(e) Given this cost base, the 95 per cent that are classed as fixed are then allocated between the line users on the following basis. The fixed charges are based on projected relative and absolute line usage by the incumbent and the access seeker. A mechanism is in place for either incumbent or third-party user to recover over- or under-payment to reflect the divergence between projected and actual line usage and third-party share of line usage.

(f) The costs for a particular line [in itself a feature that differs from other regimes] are applied in equal proportion between the following two measures, across FA and other operators in relation to their respective gross tonne km and train km. That is, the fixed charge = the cost base * (0.5 * operator's share of gtk + 0.5 * operator's share of train km).

Essential Services Commission of South Australia 2004, Rail industry guideline No. 2 (final)arbitrator pricing requirements, February. http://www.saiir.sa.gov.au/resources/documents/040213-D-RailGuideline2.pdf

See QR 2001, Access undertaking, <http://www.qr.com.au/track_access/docs/QR_Access_Undertaking_Revised.pdf> The document states (p. 41) that where the train service (e.g., non-coal trains on non-coal lines) is not subject to a Reference Tariff, the structure of charges 'will be negotiated' and the charges 'may' include an upfront fee, a periodic fixed charge (independent of usage), usage-based variable charges, or any other structure or charging combination.

** QR Network Access 2001, QR Access undertaking <http://www.qca.org.au/www/rail/QR%20Access%20Undertaking%201201_No%20Diagrams_See%20Parts%201%20&%202.pdf> Page 192 of the Undertaking provides an illustration of the reference charging, in this case, for the Newlands cluster of coal lines. There is charging (at 1 July 2001) of $1.07/'000gtk + $165/train path + $6.02/ntk +$0.90/net tonne. In essence, the long-term commitment (10 years, p. 153) to purchase track access obviates the need to set a fixed charge for recovery of overheads.

*** Australia Southern Railroad 2000, [Access] Pricing principles, 28 January, unpublished. The variable charge is derived from the annual maintenance, operations and overhead expenses. The third-party operator's share of those expenses is determined by its proportion of the gtk run on the line segment. Note, however, that if the charge is set at the ceiling price, the maintenance expenses consist of 'track and right-of-way' , 'signalling and communications' and 'facilities' expenses; the operations expenses are 'train control and signalling', 'operations' and 'train planning' expenses; and the overhead expenses consist of 'administration' expenses. Depreciation and other financial charges and capital works expenses are excluded. If the charge is set at the floor price, the only costs considered are 'track and right-of-way', 'operations' and :train planning' costs.

Appendix iii

Schematic map of axle loads on QR Network Access

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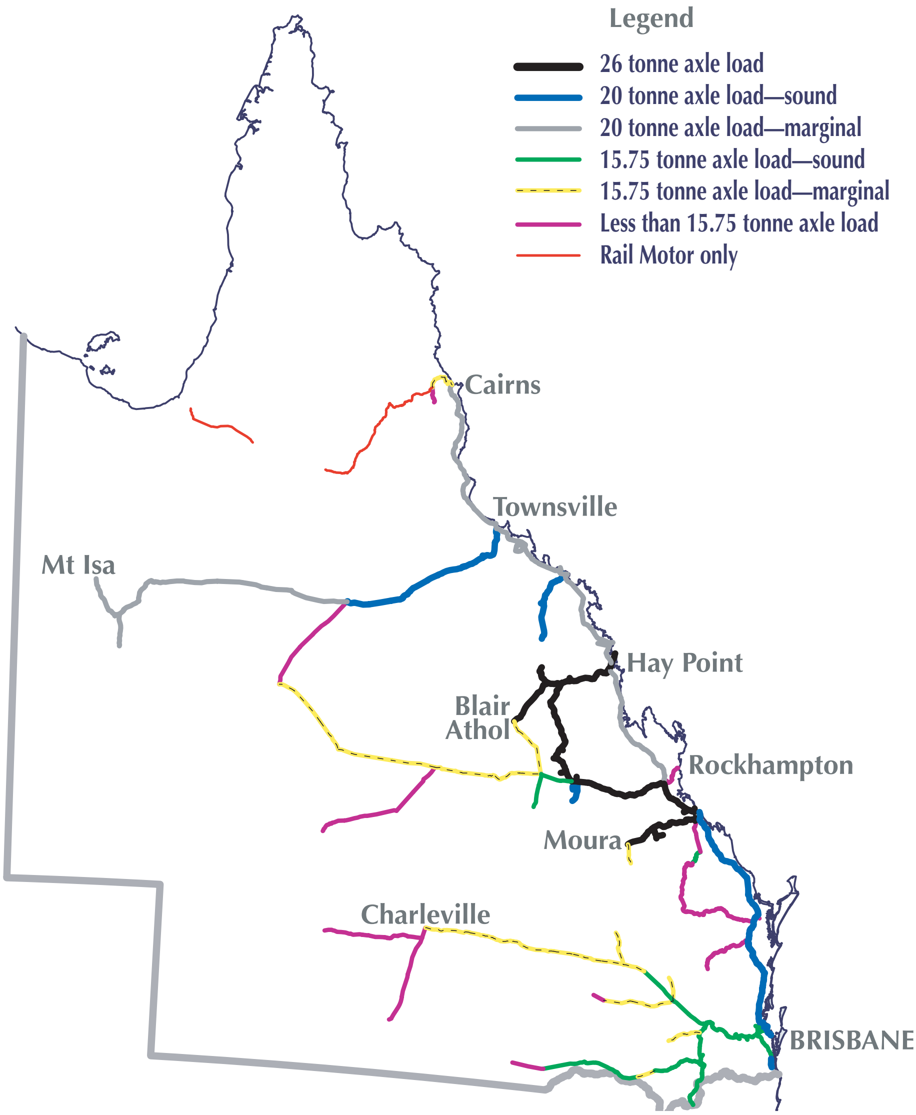
Schematic map of axle loads on QR Network Access



Source: QR Network Access 2002, *Information pack. Standard & dual gauge system*, <http://www.networkaccess.qr.com.au/Images/Simplified_Network_tcm10-2881.pdf>

Appendix iv

Principal harmonisation issues highlighted

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Regulations

Access arrangements	Mandated access arrangements - Management of access contract (Maunsell 1998) - Arbitration and dispute resolution (Maunsell 1998) Multiple regulatory regimes (Commonwealth & State) Seamless and consistent pricing and insurance arrangements (Maunsell 1998) Single-desk: access negotiation (Maunsell 1998) Train path management and train control (ACIL 2001) Seamless access processes for accreditation between DIRN and intrastate networks (Affleck 2003) Infrastructure charges (BTRE 2003)
Safety Standards Accreditation	Increased uniformity of safety standards and practices (Affleck 2003) IGA (1999) accreditation approach to safety (Maunsell 1998): - Clarify roles of network operations and safety regulators (Maunsell 1998) - Streamline accreditation processes across jurisdictions (Maunsell 1998)
Accident investigation	Single (national) body responsible for accident/incident investigation. (Transport Safety Investigation Act 2003 provides for Federal investigation powers on the DIRN)
National Code of Practice	Safe working, crew management and training (Maunsell 1998): - Develop common code of practice/uniform rule book for safe working and training for interstate railways

Infrastructure

Physical-input/output measures	Increased harmonisation of axle loads and speeds (Maunsell 1998)
Loading outline	Increased uniformity of loading outline: - loading outline clearance to 4.3m - Double stack clearances: Adelaide-Melbourne - Double stack clearances: Melbourne-Sydney-Brisbane
Trailing loads (gross train mass)	Improve train operating standards (Maunsell 1998): - Develop proposals to replace prescriptive limits with performance based limits for train braking - Economic evaluation of options to improve gross load over the Adelaide Hills
National code of practice	Uniformity (over time) of operating and technical standards on interstate and intrastate networks. Increased uniformity of rollingstock design specifications (Maunsell 1998)
Communications	Agree compatibility standards (Maunsell 1998) Priorities for modifying existing systems to give an appropriate level of compatibility (Maunsell 1998). National Code of Practice (ACIL 2001): - communications protocols and hardware; - terminologies; - signage; and - signalling.
Management Information Systems	Increase compliance and reduce the cost of information transfer between the information systems operated by different rail operators.

Appendix v

Overlap between rail regulation and OHS regulation, by jurisdiction

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Overlap between rail regulation and OHS regulation, by jurisdiction

OHS regulator	**SA** ***Workplace Services***	**Victoria** ***VIC Workcover***	**NSW** ***NSW Workcover***	**NT** ***[individual]***	**WA** ***Worksafe WA***	**QLD** ***QLD Workplace Health and Safety***	**Comcare** ***Comcare***
Rail safety regulator	Transport SA's Rail Safety & Operations Unit	Department of Infrastructure—Public Transport Safety	Independent Transport Safety and Reliability Regulator (ITSRR). Recent increase in scope and powers	Dept Infrastructure Planning and Environment—Rail Safety Unit			
Statute	Rail Safety Act 1996	Transport Act 1983 (Road and rail transport)	Rail Safety Act 2002	Rail Safety Act			
To what extent does OHS regulation overlap with rail safety regulation?	• Not a great deal—predominantly at the investigation stage • Rail safety focus is on infrastructure and public safety	• Significant overlap in compliance and investigations. Approach is predominantly reactive as shift to prevention would require significant resources • Comm-unication requirements clearly seen as OHS issue	• Enormous crossover particularly in metropolitan region and with Waterfall findings of driver ill health • WorkCover bolstering regulator's initial operational limits—significant goodwill		Examples of areas where there may be overlapping regulatory interest are in the electricity industry, mines and the maritime industry.		
How does the regulatory relationship work?	• Well. Efforts to raise awareness proving fruitful.	• Informally—through understanding of roles and notification of incidents to Workcover or through direct complaints • Mutual recognition of operator accreditation works well	• Primarily through networking and understanding of Regulator, Police, RTA and WorkCover roles and relationships		No formal arrangements between agencies, but there are understandings between them, which mean that one agency will usually act as the 'lead investigator' in the event of an incident. This generally works well		
Is the regulatory relationship formalised? For example, by an agreement or through any alignment of regulation?	• Establishment of MOU is underway • Review of ADG code and state legislation opportunities for strengthening relationship	• No MOU with rail regulator, however one in place with Police for road safety	• Verbal agreements between CEOs have been formalised with letters • MOU to be established			• QRail is a government corporation with no immunity to the OHS legislation. OHS inspectorate has clearly defined inspection powers	

Overlap between rail regulation and OHS regulation, by jurisdiction (continued)

OHS regulator	SA *Workplace Services*	Victoria *VIC Workcover*	NSW *NSW Workcover*	NT *[individual]*	WA *Worksafe WA*	QLD	Comcare *Comcare*
How is the regulatory relationship managed? For example by meetings or cross-appointment of inspectors?	• Largely by personal networking given the nature of such a small jurisdiction and through joint meetings	• Informally through understanding of relationships with other stakeholders. Transport is a Priority area for WorkCover	• Cross notification of matters e.g. identification of work at height infringements • Workcover has issued strategic OHS safe work directions and improvement notices on operators	Joint and crossover meetings of inspectorates and close cooperation		• Rail union often initiates OHS involvement in rail issues	
What practical issues have arisen from the regulatory relationship and how have they been addressed?	• Regulator unaware of OHS reporting requirements for *notifiable dangerous occurrences* • System established for electronic reporting which triggers OHS inspectorate consideration of investigation	• OHS used as IR lever—eg Driver (union) issues PIN on track owner for vibration in train cabins to force repair of track that is within acceptable rail safety parameters • Seeking a solution through stakeholder consultation	• Increased short to mid term workload on WorkCover without increase in resources as regulator becomes established • Focus on metropolitan area given Waterfall				
Can you provide any examples of problem or positive results from the relationship?	• Stakeholder meetings have raised awareness and clarified roles	• Current approach will not cope with increasing number of players required to share facilities, of track, signals, depots etc • Recent port reform an example—issues not complex, but require national approach, clarification of roles and additional resourcing	• Maintenance workshop safety addressed by joint inspection teams		Where there are major projects being planned, e.g., a mining development, the interested regulatory bodies get together with the project sponsors and managers to identify potential issues and work out how to address them		
Contact with stakeholders/comments	• Has had contact with ARTC—minimal OHS knowledge • Pacific National have convened local industry meetings	• Further example of reasonable practicability of risk management: occasional low speed, remote derailment of grain wagons considered acceptable by rolling stock owner in light of cost to rectify the fault	• Regulator powers increased significantly in response to Waterfall • OTSI operates 'no fault' accident investigation regime similar to ATSB	Minimal rail experience with recent completion of rail link			

Source: National Occupational Health and Safety Commission 2004, pp3–4.

Glossary

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Automatic Block Signalling	The driver receives the authority to proceed from a line-side signal. A pair of signals will be interlocked to prevent both signals showing 'proceed' at the same time. This contrasts with Centralised Train Control in being a passive system rather than being directly controlled from a central location
Centralised Train Control	The driver is given the authority to proceed via line-side signals. These signals are controlled from a central location.
Co-regulation	A system '…in which some of the responsibilities for regulatory development, implementation and/or enforcement are shared between industry groupings and Governments. Governments delegate certain responsibilities to industry by lending legislative backing to codes or other instruments that are primarily industry developed'. (NTC 2004, p. 1)
Direct government regulation	A system '…where a government organisation (typically an authority rather than a government department) has responsibility to develop, implement and enforce regulatory controls. There is little or no industry involvement in development and enforcement. Industry participates in implementation by putting in place systems of compliance'. (NTC 2004, p. 2)

Double-stacking	Double-stacking involves having a wagon with a payload of one container resting on top of another container.
Drawbar load	This is the maximum allowable force that can be transferred through locomotive couplings (Inter-State Commission 1987, p. 311)
Electric train staff (or token)	The system is usually used on single track. The driver may proceed between two given points (passing loops or stations) only when carrying a token or staff. The driver takes the token from an interlocking device, which prevents any further tokens to be removed until the withdrawn token is returned to one of the two interlocked receptors.
Electronic token block	The driver is given the authority to proceed from an in-cabin display via an electronic token block.
Passing loop	This is an additional track on, usually, single track, enabling trains to pass or overtake each other.
Performance-based regulation	Regulation that is '...output focused, being based on identifying what specifically needs to be achieved if the regulatory objective is to be met'. (NTC 2004, p. 2)
Prescriptive regulation	Regulation which '...focuses on input standards and specifies precisely the actions that must be taken to achieve compliance'. (NTC 2004, p. 2)

Rail Safety Acts	These acts have been enacted in the States and Territories, in response to the Intergovernmental Agreement on Rail Safety and the subsequent AS 4292.
Ring-fencing	ACCC defines 'ring-fencing' as being '...designed to assist the introduction of effective competition into markets traditionally supplied by natural monopolies. It involves putting structures into place to prevent flows of information and personnel, and inappropriate transferring of costs and revenues within an integrated utility and between related businesses' (ACCC web site, <http://www.accc.gov.au/gas/ring_fence/code_reqs_rf.htm>
Safety management system	This is defined as '...any system whose primary object is to achieve safe rail operations' (Accreditation Authorities, p. 2). It applies to both the infrastructure manager's system and the train operator's system. The system includes codes, standards, procedure and infrastructure (Ibid., p. 28). Generally, AS 4292 is used to define the minimum requirements for such a system. The infrastructure manager requires the train operator to adopt the infrastructure codes of practice/safeworking rules.
Safeworking	This is the system of operating procedures and equipment that is designed to ensure safe operations on and around the railway.

Self-regulation	This is a system '…in which there is very limited government intervention. Government does not participate in regulatory development, implementation and enforcement. Government may encourage industry to develop such a system as an alternative to being regulated formally by government' (NTC 2004, p. 1) Under self-regulation, an industry adopts its own operational and technical standards, working practices or processes. As noted elsewhere (Better Regulation Task Force, p. 46), advantages of self-regulation over classic regulation include that the codes and schemes can be quickly implemented and saves establishment and enforcement costs. Disadvantages include that voluntary adoption may mean that it is less effective than classic regulation; also, the regulation may be unduly influenced by large companies.
Train order: paper or voice authority	The driver receives authority to proceed to a specified location by a written or verbal request.
Well wagon	A well wagon is an open wagons with a low central floor, straddled between, rather than above, the set of bogies. The low floor enables higher payloads-containers or double-stacked containers-to be carried.

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